

**A SUMMARY OF PATTERNS IN CHINOOK SALMON BYCATCH
IN THE BERING SEA AND GULF OF ALASKA**

A Briefing Document for the NPFMC Bycatch Committee

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General Data Considerations and Assumptions

Data cover the years 1980 - 1990 in the Bering Sea / Aleutian Islands and the years 1980 - 1989 in the Gulf of Alaska, and are from haul-by-haul observer reports which have not been expanded to the total catch. Observer coverage during this period increased from 29.2% in 1980 to 82.6% in 1984 and 94.2% in 1989.

This data includes the joint venture (JV) fisheries and the 1990 domestic data to a limited extent. Because the foreign fleet was required to maintain chinook bycatch within specific levels beginning in 1982, the foreign data was not considered to be representative of the bycatch patterns experienced by the unrestricted JV and domestic fleets.

The data provided the number and weight of salmon in each haul. The haul-specific percentage of chinook salmon in the JV fisheries from observer sampling was available for 1986, and some data from 1988 and 1989 were available as well. The percentages used to determine the numbers of chinook salmon in each year were taken from annual NMFS observer sampling reports. Monthly variability in the percentage of chinook salmon each year was analyzed, and found to not significantly differ from the results presented below. The annual NMFS percentages were as follows:

<u>YEAR</u>	<u>BERING SEA JV % CHINOOK</u>	<u>GULF OF ALASKA JV % CHINOOK</u>
1980	100.0%	100%
1981	37.0%	0
1982	70.81%	84.88%
1983	2.12%	84.61%
1984	2.58%	99.07%
1985	24.22%	99.33%
1986	25.02%	99.71%
1987	77.56%	62.36%
1988	59.91%	59.62%
1989	60.72%	NF

The data were made available to the nearest minute of latitude and longitude. However, the data were summarized to the nearest 1/2 degree latitude by 1 degree longitude (hereafter referred to as a "1/2 X 1 block") for this analysis. Data observations extended as far west as approximately 178 degrees East in the Bering Sea, and as far west as approximately 170 degrees West in the Gulf of Alaska. However, to improve the resolution of the maps, observations only extended to 180 degrees East in the Bering Sea and to 168 degrees West in the Gulf of Alaska. The number of observations beyond these cutoff longitudes was very small.

The two target fisheries which caught the major portion of chinook salmon during the years 1980 - 1989 in both the Bering Sea and the Gulf of Alaska were the pelagic trawl for pollock and the bottom trawl for pollock. The bottom trawl fishery for Pacific cod in the Bering Sea and Gulf of Alaska, and the rockfish and flatfish fisheries in the Gulf of Alaska are presented as well.

To maintain consistency in assigning hauls to target fisheries, the 1991 conventions were used. These conventions are as follows and each haul was assigned to the first applicable target fishery:

In the Bering Sea:

- If pollock make up 95% or more of the haul, then the target = P;
- Otherwise, if greenling turbot make up at least 35% of the haul, then the target = T;
- Otherwise, if Pacific cod make up at least 45% of the haul, then the target = C;
- Otherwise, if rock sole, other flatfish or yellowfin sole make up at least 40% of the haul, then the target = F;
- Otherwise, if pollock make up at least 20% of the haul, then the target = B;
- Otherwise, if arrowtooth flounder make up at least 20% of the haul, then the target = W;
- Otherwise, if rock fish make up at least 35% of the haul, then the target = K;
- Otherwise, if sablefish make up at least 20% of the haul, then the target = S;
- Otherwise, if Atka mackerel make up at least 20% of the haul, then the target = A;
- Otherwise, the target = O.

In the Gulf of Alaska:

- If pollock make up 95% or more of the haul, then the target = P;
- Otherwise, if Pacific cod make up at least 45% of the haul, then the target = C;
- Otherwise, if rock fish make up at least 35% of the haul, then the target = K;
- Otherwise, if pollock make up at least 20% of the haul, then the target = B;
- Otherwise, if rock sole, other flatfish or yellowfin sole make up at least 20% of the haul, then the target = D;
- Otherwise, if greenling turbot make up at least 20% of the haul, then the target = H;
- Otherwise, if sablefish make up at least 20% of the haul, then the target = S;
- Otherwise, if arrowtooth flounder make up at least 20% of the haul, then the target = W;
- Otherwise, the target = O.

The data summarized for each month, target fishery and $1/2 \times 1$ block over all years, were the mean groundfish catch, the mean number of chinook salmon caught, and the bycatch rate expressed as

the number of chinook salmon captured per metric ton of ground fish (total number/total weight).

This report is divided into the following sections:

1. A summary of patterns in chinook salmon bycatch based on monthly maps for each fishery.
2. A comparison of 1990 domestic data vs the 1980 - 1989 JV data in two Bering Sea fisheries.

1. Summary of Monthly Patterns In Chinook Salmon Bycatch

Key to figures for each month:

For the JV data, the mean number of bycaught chinook salmon in each block was calculated by summing the yearly total number of chinook salmon in a block and dividing the sum by the number of years for which there were observations. These means were then ranked from highest (1) to lowest. An asterisk (*) indicates no bycaught chinook salmon. The mean groundfish catch for a block was similarly calculated by summing the total annual groundfish catch in a block over all years with observations and dividing by that number of years. Mean groundfish catch was also ranked from highest to lowest. The bycatch rate was calculated by summing the total number of salmon in a block over all years and dividing by the sum of the total tons of groundfish in that block over all years.

In each month, the blocks with the five highest bycatch means were determined, and the number of these blocks which were adjoining were examined. This gave some indication of the dispersion of locations with high bycatch. The blocks with the five highest groundfish catch means were also determined, and the extent to which these blocks were coincident with the blocks with the five highest bycatch means was examined as well.

Bering Sea - Bottom Trawl for Pollock

In November, December, and January the fleet for the most part does not range far from the shelf area north of Unimak Is. In these months, groundfish catch, chinook salmon bycatch and bycatch rates all tend to be low. However, as was seen in January and December, there can be a great amount of variability in the bycatch and bycatch rates so that a single block can have exceptionally high bycatch and/or bycatch rates. Areas of high catch are coincident

with areas of high bycatch because of the relatively small area fished.

[January (Figures 1-4): High bycatch (275 fish), especially in one block; high catch (3,000 mt); low bycatch rate, except for one block (3.26 chinook/mt); 4 contiguous blocks; Catch and bycatch coincident. Approximately 80% of the total mean number of chinook were taken in a single block located in the northwest section of the shelf break. This block contributed approximately 0% of the total mean groundfish catch.]

In February, March and April, the blocks with high bycatch tend to be near Unimak Is. or the shelf break, and the blocks with high catch tend to be north or to the east of the high bycatch blocks. The amount of catch per block tends to increase from February to April, but the bycatch for the most part remains low. High bycatch rates tend to occur where high bycatch is found. The blocks with high bycatch tend to be contiguous and near the Unimak Pass/Horseshoe area.

[March (Figures 5-7): Low bycatch (11 fish); high catch (3,800 mt); higher bycatch rates (.22 chinook/mt); 5 contiguous blocks; catch and bycatch separate. The five blocks with the highest mean number of bycaught chinook were all contiguous and near the horseshoe and shelf break. These five blocks contributed 85% of the total mean number of bycaught chinook, but amounted to only 17% of the total mean groundfish catch.]

In May, June and July, catch drops off from the spring levels. Fishing effort is spread across the shelf. Bycatch levels and rates are very low. Blocks with high bycatch are dispersed but occur along the shelf break or closer to land. Blocks with high catch often overlap blocks with high bycatch.

[July (Figures 8-10): Low bycatch (4 fish); moderate (2,500 mt); low bycatch rates (.02 fish/mt); 3 contiguous blocks; catch and bycatch somewhat separate.]

In August and September, catch is moderate and dispersed across the shelf. Bycatch levels tend to be high with high bycatch rates. Blocks with high bycatch are in the area north of Unimak Is. or along the shelf break. These blocks are for the most part adjoining and separate from blocks with high catch.

[August (Figures 11-14): High bycatch (250 fish); lower catch (1,900 mt); increasing bycatch rates (.37 chinook/mt); 5 contiguous blocks; catch and bycatch somewhat separate. The five blocks with the highest mean bycatch of chinook salmon were adjoining and located north of the "horseshoe". Approximately 91% of the total mean number of bycaught chinook salmon were found in these five blocks, which contributed 28% of the total mean groundfish catch. The two highest ranked blocks for groundfish catch were within these five blocks as well.]

In October, the catch is high, however, bycatch and bycatch rates are reduced. Blocks with high bycatch are dispersed and found along the Aleutian Chain, north of Unimak Is., or along the shelf break. These blocks tend to be associated with blocks of high catch.

Bering Sea - Pelagic Trawl for Pollock

In January, October, November and December, the fleet for the most part did not range far from the shelf break or away from the Unimak Is./Horseshoe area. Bycatch tended to be high during these months, and the catch tended to be small. Bycatch rates were variable, but higher in December than in October, November or January. Blocks with high bycatch were contiguous and found near the horseshoe, north of Unimak Is., or at the north west end of the shelf break. Blocks with high catch were for the most part coincident with these high bycatch blocks.

[January (Figures 15-18): High bycatch (105 fish); relatively low catch (7,600 mt); relatively low bycatch rate (.064 chinook/mt); 4 contiguous blocks; catch and bycatch coincident. The four blocks ranked highest for chinook bycatch comprised 66% of the total mean number of bycaught chinook salmon and 47% of the total mean groundfish catch.]

February was a month with lower bycatch and bycatch rates. The high bycatch blocks were contiguous and centered in the horseshoe area which was also where high catches were found. Catch levels in this month were extremely high.

[February (Figures 19-21): Reduced bycatch from January (70 fish); high catch (24,000 mt); low bycatch rate (.027 chinook/mt); 4 contiguous blocks; catch and bycatch coincident.]

In March and April, blocks with high bycatch were dispersed and located generally along the shelf break or the Aleutian Chain. The blocks with high catch were not as highly associated with the blocks of high bycatch, and effort was distributed over the southeast area of the shelf. Relatively high catch and bycatch were seen in these months.

[April (Figures 22-24): Higher bycatch than March (122 fish); lower catch (from Feb. and Mar. levels) (13,000 mt); high bycatch rates (.54 chinook/mt); 2 contiguous blocks; catch and bycatch separate.]

May was a month in which blocks of high catch and high bycatch were separate. The blocks with high catch tended to be north and west of the blocks with high bycatch. Bycatch was moderate and bycatch rates were still fairly high, however catch per block was reduced from earlier levels.

[May (Figures 25-27): Lower bycatch (47 fish); low catch

(9,000 mt); some high bycatch rates (.18 chinook/mt); three contiguous blocks; catch and bycatch separate. The blocks with the five highest bycatch levels occurred between 56 degrees to 57 degrees latitude, and -168 degrees to -171 degrees longitude. Roughly 55% of the total mean bycatch of chinook salmon and 13% of the total groundfish catch occurred in these five blocks.]

Catch, bycatch and bycatch rates were all reduced in June and July. Blocks of high bycatch tended to occur along the shelf break, and blocks with high bycatch often overlapped with blocks of high catch.

[July (Figures 28-30): Low bycatch (25 fish); moderate catch (8,200 mt); low bycatch rates (.006 chinook/mt); 3 contiguous blocks; catch and bycatch coincident.]

In August and September, the mean bycatch levels and the bycatch rates were very high. Catch was moderate and blocks of high catch tended to be contiguous and located at the northwest end of the shelf break, whereas the blocks with high bycatch tended to be contiguous and located in the area north of Unimak Is. There is a very pronounced separation of high catch from high bycatch areas.

[August (Figures 31-34): High bycatch (190 fish); moderate catch (8,000 mt); high bycatch rates (.189 chinook/mt); 5 contiguous blocks; catch and bycatch separate. The five blocks with the highest mean number of bycaught chinook salmon were contiguous and located north of the "horseshoe" and Unimak Is. Together, 74% of the total mean chinook salmon bycatch and 13% of the total mean groundfish catch was taken in these five blocks.]

Bering Sea - Bottom Trawl for Pacific Cod

Fishing effort in November, December, January and February was restricted to the area near the "horseshoe" and Unimak Island. Blocks with high bycatch were coincident with blocks of high catch. November and December had relatively low catch, and January and February had relatively higher catches. Bycatch and bycatch rates were low.

[January (Figures 35-37): Low bycatch (12 fish); high catch (3,900 mt); low bycatch rates (.027 chinook/mt); 5 contiguous blocks; catch and bycatch coincident. The block with the highest mean bycatch contributed 47% of the total mean bycatch and 6% of the total mean groundfish catch.]

Fishing effort expanded onto the shelf, along the shelf break, and along the Aleutians during March, April and May. The highest mean groundfish catch declined over this period, but bycatch of chinook salmon remained high. Areas of the highest catch were often coincident with areas of high bycatch, however, the blocks with the

highest mean bycatch were found near the horseshoe and Unimak Is. while high catch was often found further into the shelf.

[April (Figures 38-40): High bycatch (50 fish); moderate catch (1,000 mt); high bycatch rates (.304 chinook/mt); 5 contiguous blocks; catch and bycatch somewhat separate. The 5 blocks ranked highest for mean bycatch contributed 95% of the total mean bycatch and 37% of the total mean groundfish catch.]

As in the pollock fisheries, catch, bycatch and bycatch rates were all reduced in June, July, August, and September, and fewer blocks were fished in August and September than had been fished in June and July. Blocks with high bycatch often overlapped with blocks of high catch.

[June (Figure 41): Low bycatch (1 fish); low catch (530 mt); low bycatch rates (.004 chinook/mt); 2 contiguous blocks; catch and bycatch separate. Bycatch was only seen in four of forty blocks.]

October bycatch was concentrated along the "horseshoe" and overlapped with blocks of high catch. Bycatch and bycatch rates were higher than those seen in the summer months and catch increased from summer levels as well.

[October (Figure 42): Moderate bycatch (20 fish in a single block); moderate catch (1,000 mt); high bycatch rates (.115 chinook/mt); 4 contiguous blocks; catch and bycatch coincident. The block ranked highest for mean bycatch contributed 66% of the total mean bycatch and 53% of the total mean groundfish catch.]

Gulf of Alaska - Bottom Trawl for Pollock

The bottom trawl fishery for pollock does not occur over a broad range of separate blocks, so it is difficult to determine spatial patterns in chinook salmon bycatch. A feature which is prominent in the data, however, is the extremely high bycatch and bycatch rates which are found in October, November and December. There was a high mean bycatch seen in February of 130 chinook salmon (Figures 43-44), and another high mean bycatch seen in August of 190 chinook salmon, but these levels are small compared to the high mean bycatches of 1,200 chinook, 3,800 chinook, and 1,200 chinook for October (Figures 45-46), November (Figures 47-48), and December, respectively. Analysis has shown that the means for these blocks are often because of several years of high bycatch within a block and are not necessarily single year events. There is a tendency for the blocks with high bycatch rates to be located to the south and west of Kodiak Is.

Gulf of Alaska - Pelagic Trawl for Pollock

The pelagic trawl fishery for pollock suffers from the same constraints as the bottom trawl fishery in that the fishery does not extend over a broad range of blocks making spatial patterns in chinook bycatch difficult to determine. The mean bycatch levels tended to be higher than were those seen in the bottom trawl fishery, however the same increase in mean bycatch levels in October, November and December was still apparent. Months with high mean bycatch levels included February (Figure 49) with 600 chinook, March with 300 chinook, and September (Figure 50) with 800 chinook. The high mean bycatch levels for October (Figures 51-52), November (Figures 53-54), and December were 4,800 chinook, 1,800 chinook, and 1,400 chinook, respectively. As was the case with the bottom trawl fishery, the blocks with the highest mean chinook bycatch were located to the south and west of Kodiak Is.

Gulf of Alaska - Bottom Trawl for Pacific cod

As with the pollock fisheries, the small number of blocks fished in any particular month makes areal patterns in chinook bycatch difficult to determine. The bycatch of chinook salmon was reduced from the levels seen in the pollock fisheries. Two of the months with highest mean bycatch were, again, November and December with a high mean bycatch of 155 chinook and 135 chinook, respectively. The month having the block with the highest mean bycatch, however, was July with 260 bycaught chinook salmon. Other months with relatively high mean bycatch levels were January with 47 chinook, April with 52 chinook, May with 54 chinook.

Gulf of Alaska - Bottom Trawl for Rockfish

Little or no effort was seen in this fishery until the month of April. Throughout the year the majority of effort was found to the south of the Alaska Peninsula and Unimak Island but did not extend over a large area. Bycatch in this fishery was for the most part low. A high mean bycatch of chinook salmon from a single block was seen in August (40 chinook salmon). April also had a high mean bycatch of 35 chinook.

Gulf of Alaska - Bottom Trawl for Flatfish

The flatfish fishery was somewhat similar to the rockfish fishery in bycatch of chinook salmon. Effort was largely seen to the south of Kodiak Island, and little or no effort was seen in February through April. The highest mean bycatch from a single block was seen in July (60 chinook). January and September had similar high mean bycatches of 33 and 39 chinook, respectively.

2. Comparison of 1990 observer data with the JV data

Rank maps similar to those presented above were prepared for the domestic fishery in 1990. The numbers ranked for comparison were the total number of salmon and total tons of groundfish catch because data from this fishery was available for only a single year. The two target fisheries chosen for comparison were the pelagic and bottom trawl fisheries for pollock. Because the data represent only one year, maps with bycatch rates and graphs which identify a specific block could not be presented in order to protect confidentiality of vessels. This presentation may be provided in the future. There was no annual percent chinook composition available for 1990, so the sample percent composition from each haul was used to estimate the total number of chinook in a block in each month. The monthly estimates of percent chinook salmon composition were very similar to those seen in the 1986 JV data.

Overall, the patterns in chinook bycatch between domestic and JV data were similar, and suggest that the 1980-1989 JV data may offer a useful historical perspective to the ongoing domestic fisheries. The data for both the JV and domestic fisheries are summarized by month. There is a tendency for the trends noted below to be off by a month in some cases, so year to year variation in the numbers presented here must be considered as a factor.

Bering Sea - Bottom Trawl for Pollock

Absolute numbers:

There was a tendency for bycatch to be low but erratic in the winter months, to be moderate to low in the spring, become very low in the summer and increase sharply in the fall. As was discussed above, catch and bycatch in November, December and January tended to be low overall, but there was a potential for single high observations to occur. In the JV fishery, June and July had very low bycatch rates and there was a jump in bycatch and bycatch rates in August. This jump appeared in July in the domestic data. Since the data was aggregated over a month, this jump following the summer may have occurred within a closer time interval than a month (e.g. the jump may have occurred in late July in one case and early August in another). There was an increase in bycatch rates with low associated catch at the end of the year. The increased rates tended to appear in October in the domestic data, and in November in the JV data.

Areal patterns:

The general location of blocks with high bycatch and high catch were very similar between the domestic and the JV data. Differences were apparent when the locations being fished did not overlap. The domestic data covered only a single year, and so the

bycatch rates in locations not fished in 1990 were unknown.

In January (Figure 55) and February the locations of highest mean bycatch were very similar with a high degree of overlap between areas of high catch and areas of high bycatch. Bycatch during these months was highest north of Unimak Is., and along the "horseshoe". March and April (Figure 56) were also similar in that high bycatch tended to occur along the break or near Unimak Is., while high catch was seen in blocks which tended to be further northeast into the main shelf area. In May, June (Figure 57) and July when bycatch rates tended to be low, blocks with high catch and high bycatch overlapped somewhat and were scattered throughout the region being fished. In both the domestic and JV fishery, the highest bycatch tended to be centered in the area north of Unimak Island, and high catch generally was found further into the main shelf area or to the northwest along the shelf break. In September in both cases, bycatch was found in blocks closer to the shelf break and generally occurred in blocks scattered along the break or north of Unimak Is. The differences in areas being fished began to show in the last three months of the year. October in the domestic fishery was similar to the August (Figure 58) fishery with high bycatch at Unimak Is. and high catch to the northwest along the break. October in the JV fishery was similar to the September fishery with blocks of high bycatch being generally scattered. Domestic and JV fishing did not occur in similar areas during the months of November (Figure 59) and December.

Bering Sea - Pelagic Trawl for Pollock

Absolute numbers:

As was the case with the data from the domestic and JV bottom trawl fisheries, the bycatch rates in January tended to be low with some higher individual rates. In the case of the pelagic trawl fisheries, bycatch tended to be high because of the high catch which occurred in the first quarter of the year. The domestic and JV catch and bycatch levels for January were very similar. Again, as was the case with the bottom trawl fisheries, the JV fishery tended to have lagged the JV fishery trend by one month. The low bycatch and bycatch rates seen in April were similar to those seen in May in the JV fishery. Similarly, the June and July patterns of almost nonexistent bycatch in the JV fishery were seen during May and June in the domestic fishery. The great increase in both bycatch and bycatch rates seen in the August JV fishery was identical to the increase seen in the July domestic fishery. The patterns seen for the remainder of the year were very similar between the domestic and JV fisheries.

Areal patterns:

The general location of blocks with high bycatch and high catch were very similar between the domestic and the JV data. Differences were apparent when the locations being fished do not overlap. The domestic data covered only a single year, and so the bycatch rates which would occur in locations not fished in 1990 are unknown.

The pelagic trawl fisheries in January (Figure 60) and February did not span a large number of blocks, and so blocks of high catch and high bycatch tended to overlap. In both months over both fisheries, the blocks with the highest bycatch tended to occur in the region near or within the "horseshoe", north of Unimak Is., and along the Aleutian Chain. The blocks of high bycatch became dispersed and occurred along the shelf break and along the Aleutians in the March JV data, but were adjoining and centered north of Unimak Is. in the March domestic data. The blocks of high catch did not tend to overlap blocks of high bycatch. In April (Figure 61), the blocks of high catch occurred at the northwest extent of fishing effort. Blocks of high bycatch tended to occur along the shelf break in the JV data, and to the south and east of the high catch blocks in the domestic data. Note that the shelf break was not heavily fished in the 1990 domestic data.

In May, June, and July (Figure 62) there was a large degree of separation between blocks of high catch and blocks of high bycatch, especially in the domestic fishery. The blocks of high catch followed the April tendency to occur at the northwest extent of the fishing effort, and high bycatch occurred to the southeast of this area. The separation of high catch and high bycatch areas was greatest in the July domestic fishery when catch was far to the northwest and bycatch centered well to the south in the area to the north of Unimak Is. This pattern was not as obvious in the JV fishery during the months of June and July, but the high degree of separation seen in the domestic fishery data in July was apparent in the JV fishery data in August. The month of July in the domestic fishery and the month of August in the JV fishery each saw large increases in the number of bycaught chinook salmon from prior month levels.

In September, the pattern was similar to that seen in August in both fisheries, however, there was a greater tendency for some of high bycatch areas to occur to the north and for some of the high catch areas to occur to the south.

In October, areas of high catch and areas of high bycatch tended to overlap and were found along the extent of the shelf break and along the Aleutian Islands. The areas fished during November (Figure 63) and December were dissimilar in the domestic and JV fisheries, so no comparison of patterns in chinook salmon bycatch could be made.

January, 1980 - 1989. Mean King/Mean Catch, Bottom Trawl Pollock

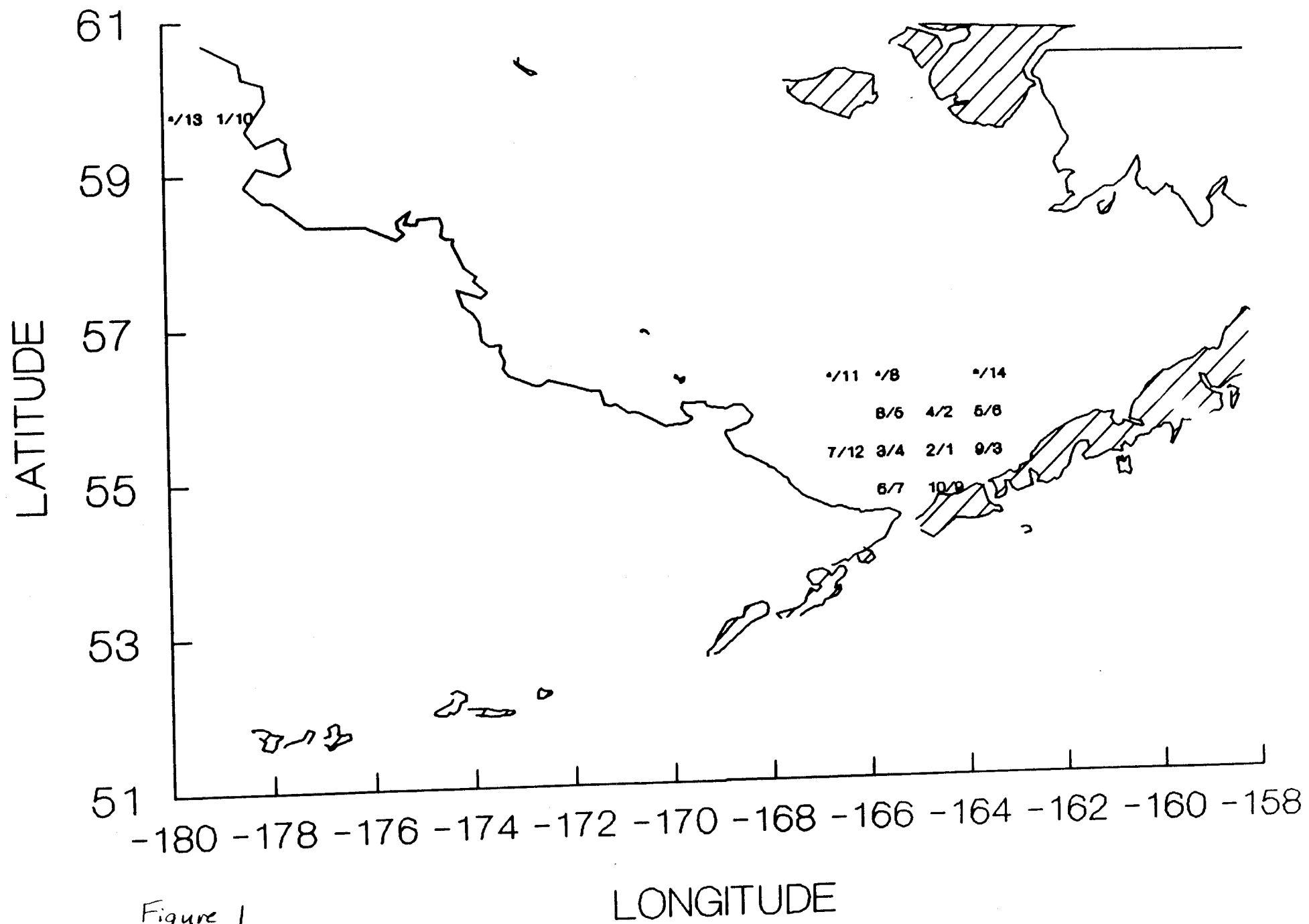


Figure 1

January, 1980 - 1989. Bycatch Rate. Bottom Trawl Pollock

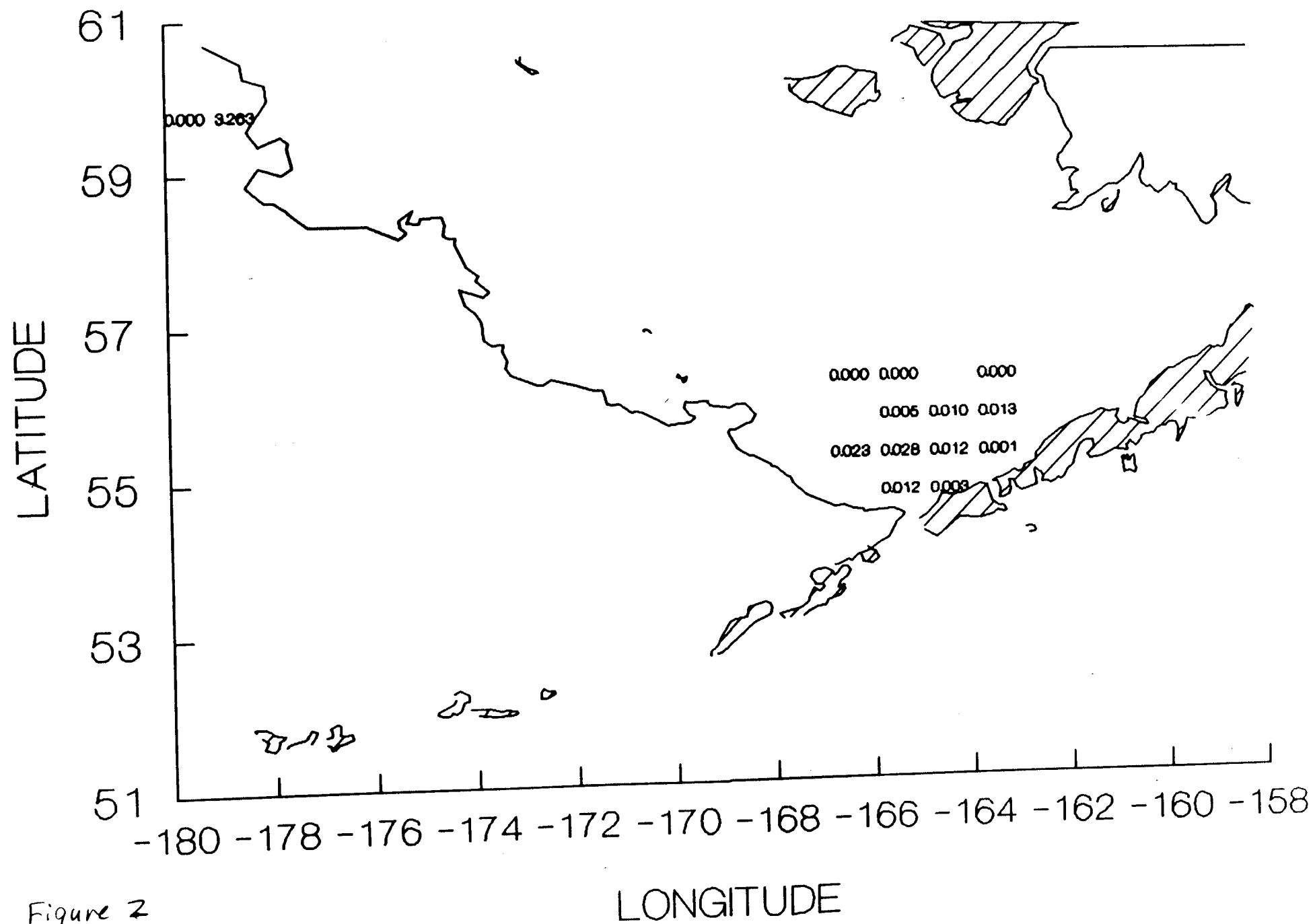


Figure 2

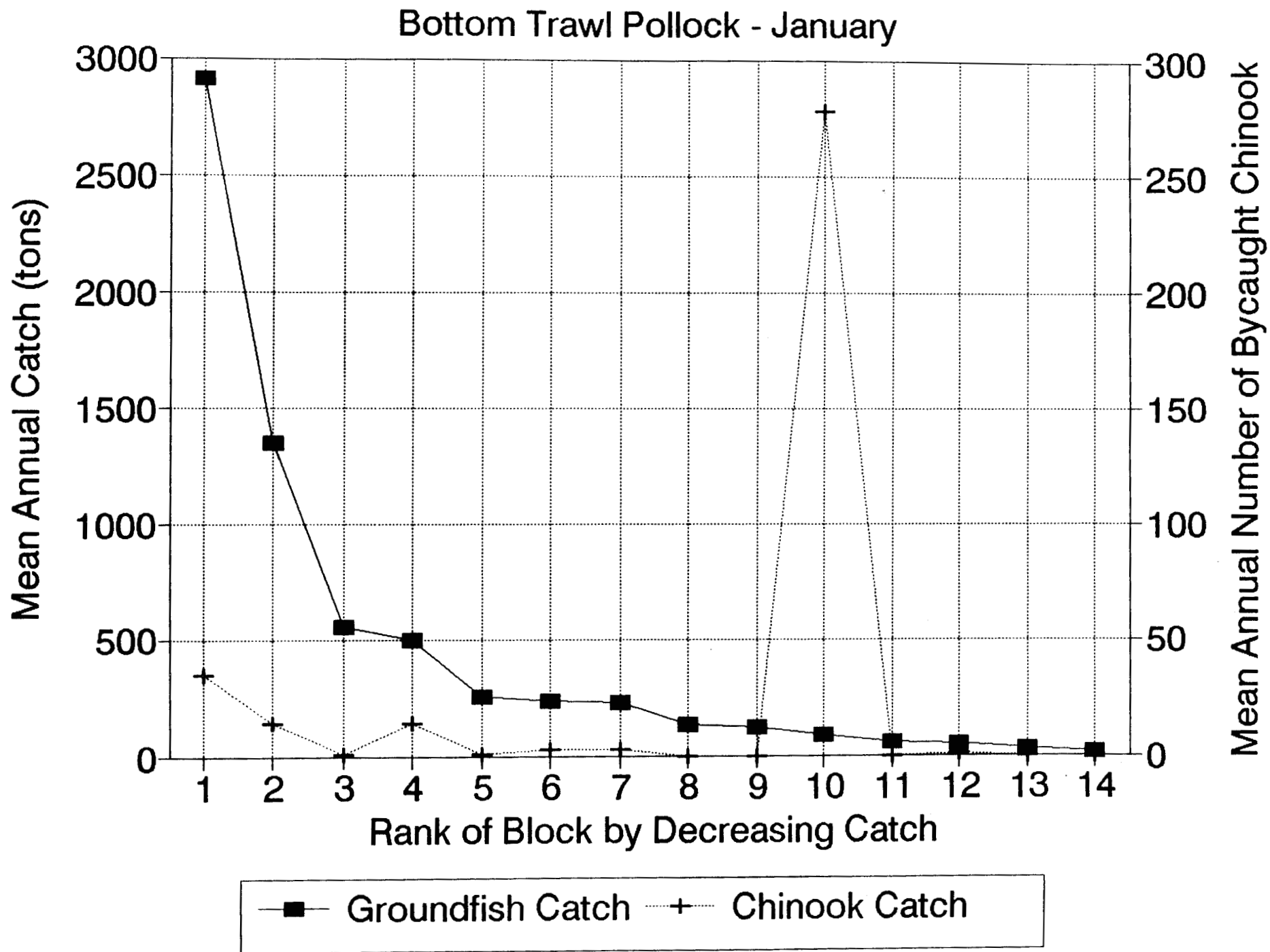


Figure 3 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the bottom trawl fishery for pollock during the month of January.

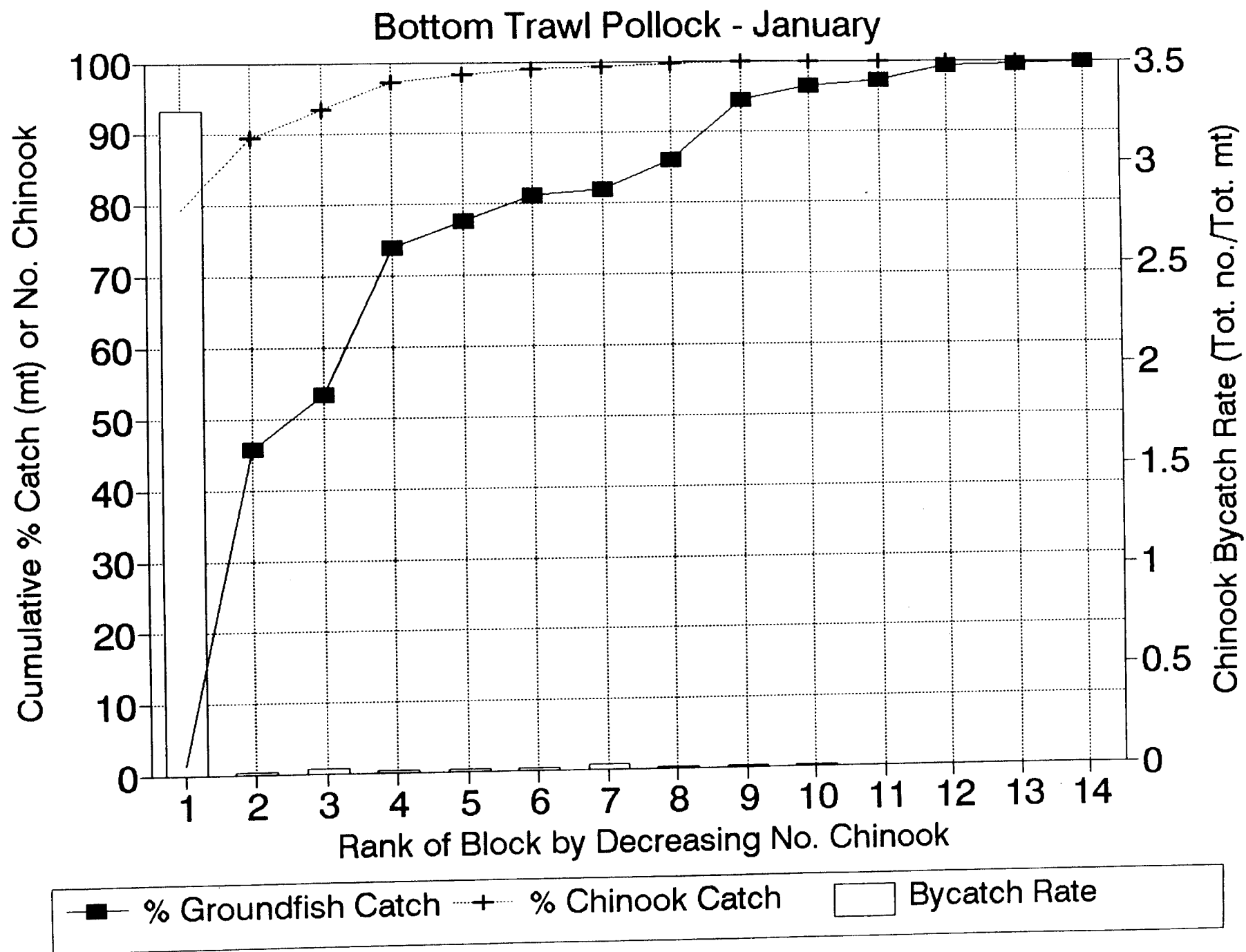


Figure 4 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the bottom trawl fishery for pollock during the month of January. Bycatch rates for each block are indicated by histograms

March, 1980 - 1989. Mean King/Mean Catch. Bottom Trawl Pollock

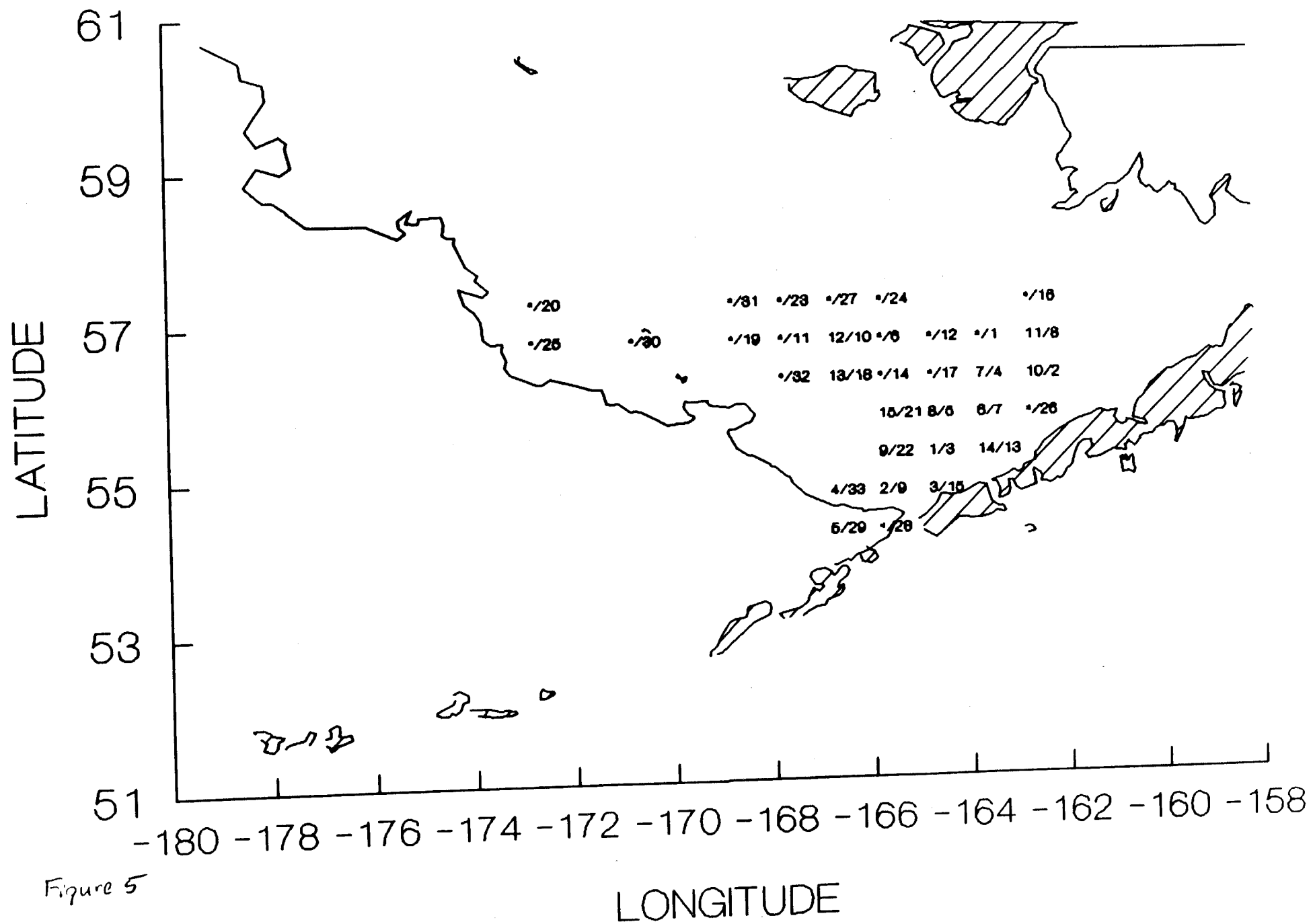


Figure 5

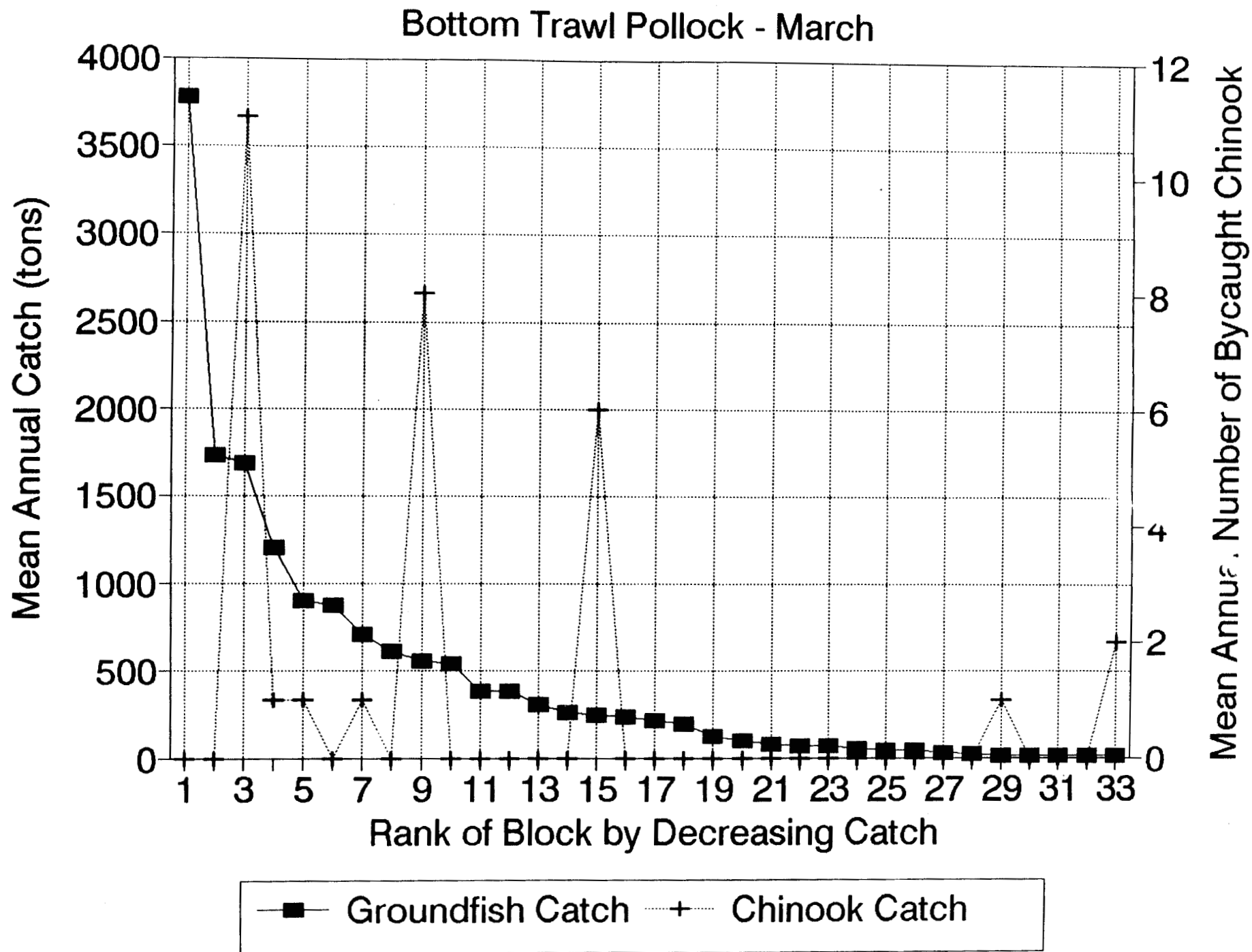


Figure 6 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the bottom trawl fishery for pollock during the month of March.

Bottom Trawl Pollock - March

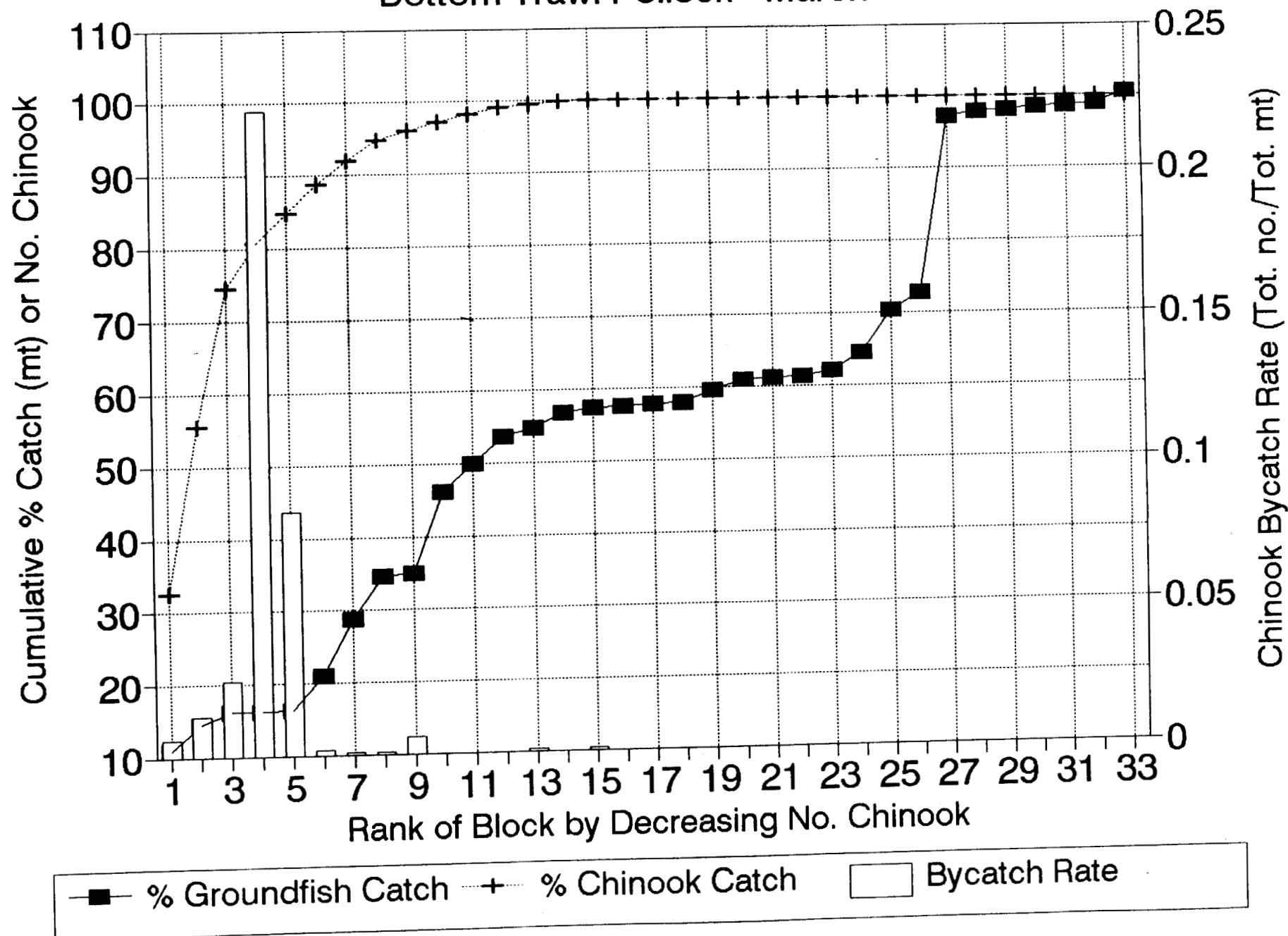


Figure 7 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the bottom trawl fishery for pollock during the month of March. Bycatch rates for each block are indicated by histograms.

July, 1980 - 1989. Mean King/Mean Catch. Bottom Trawl Pollock

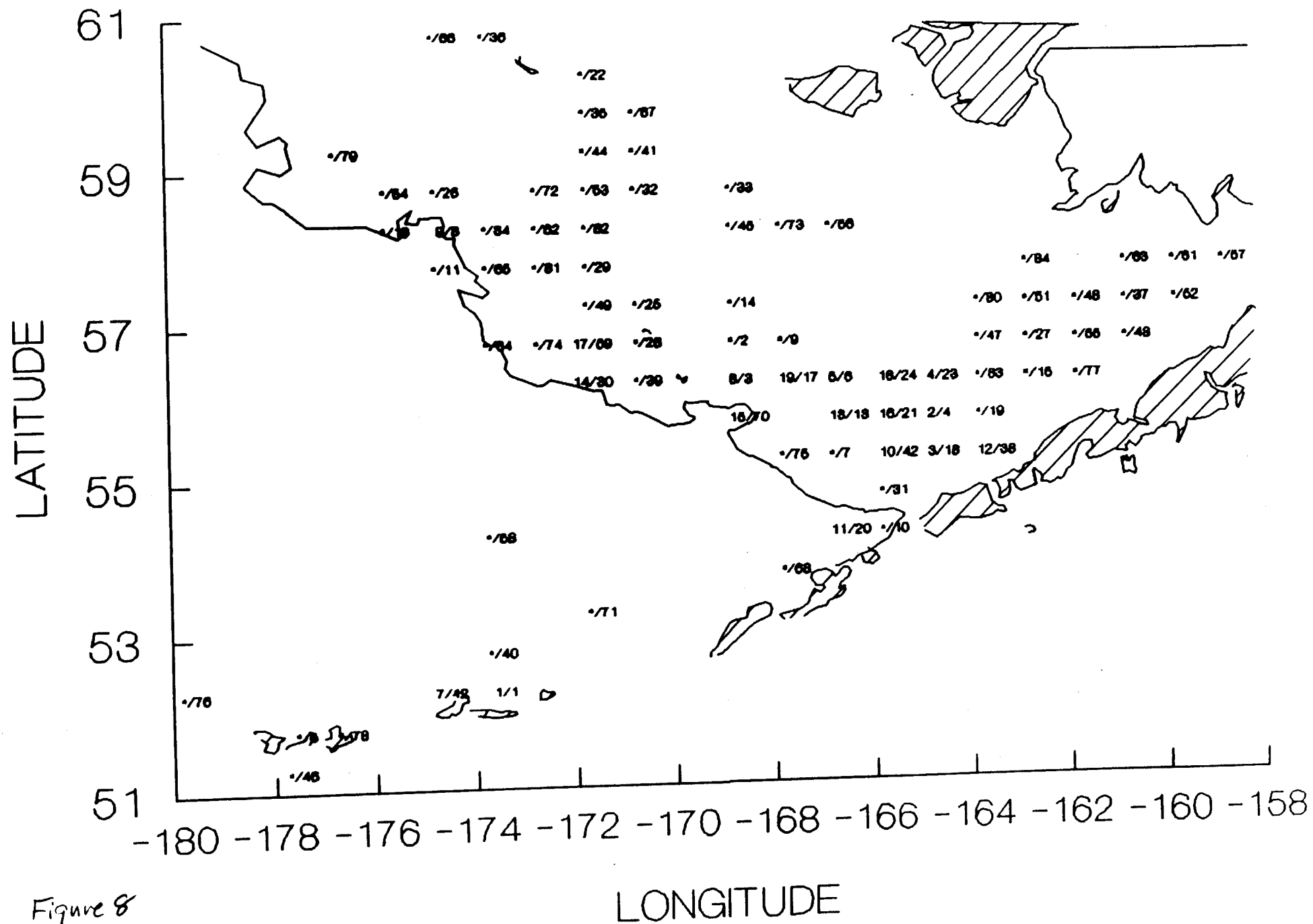


Figure 8

Bottom Trawl Pollock - July

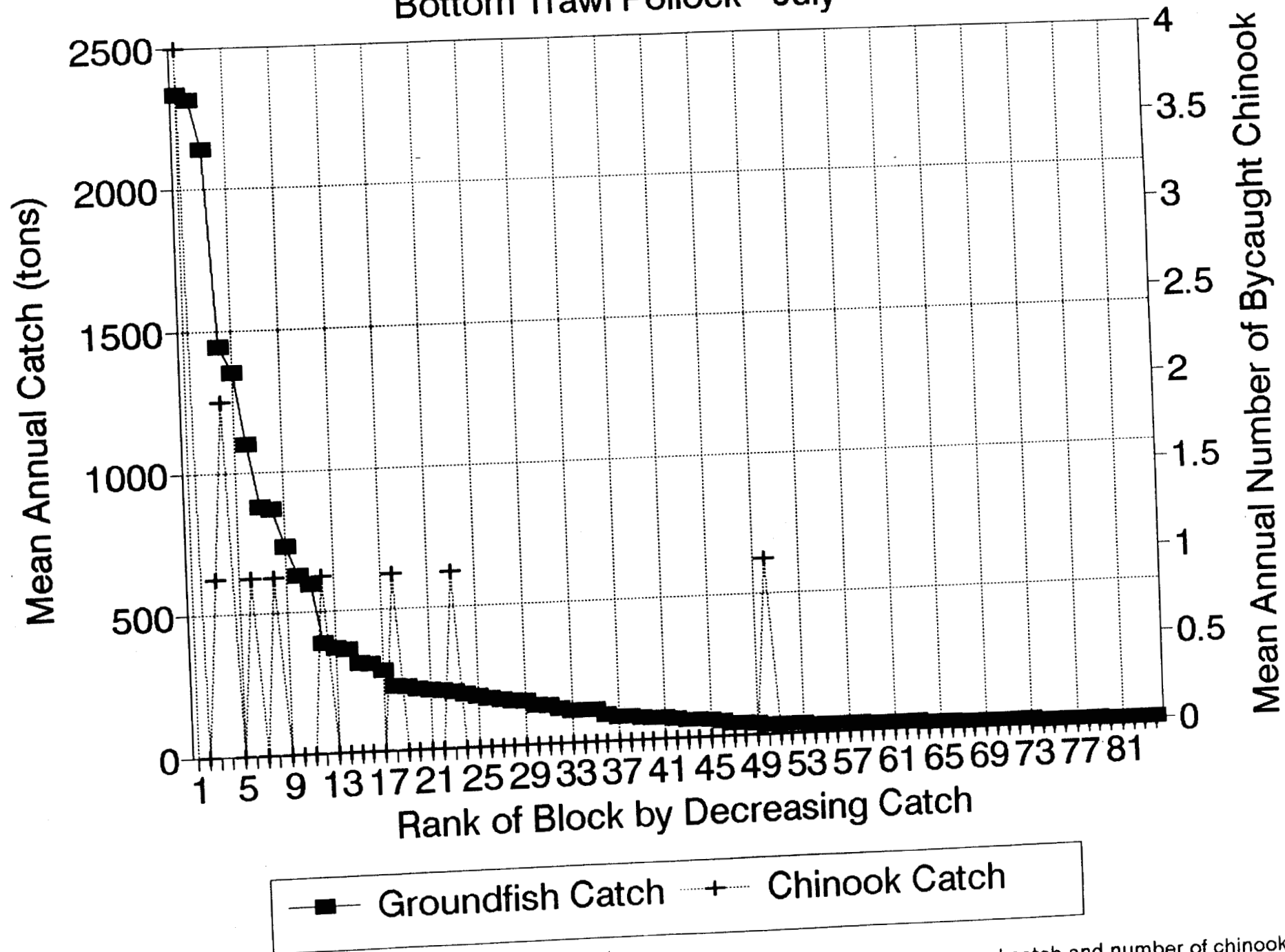


Figure 9. One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the bottom trawl fishery for pollock during the month of July.

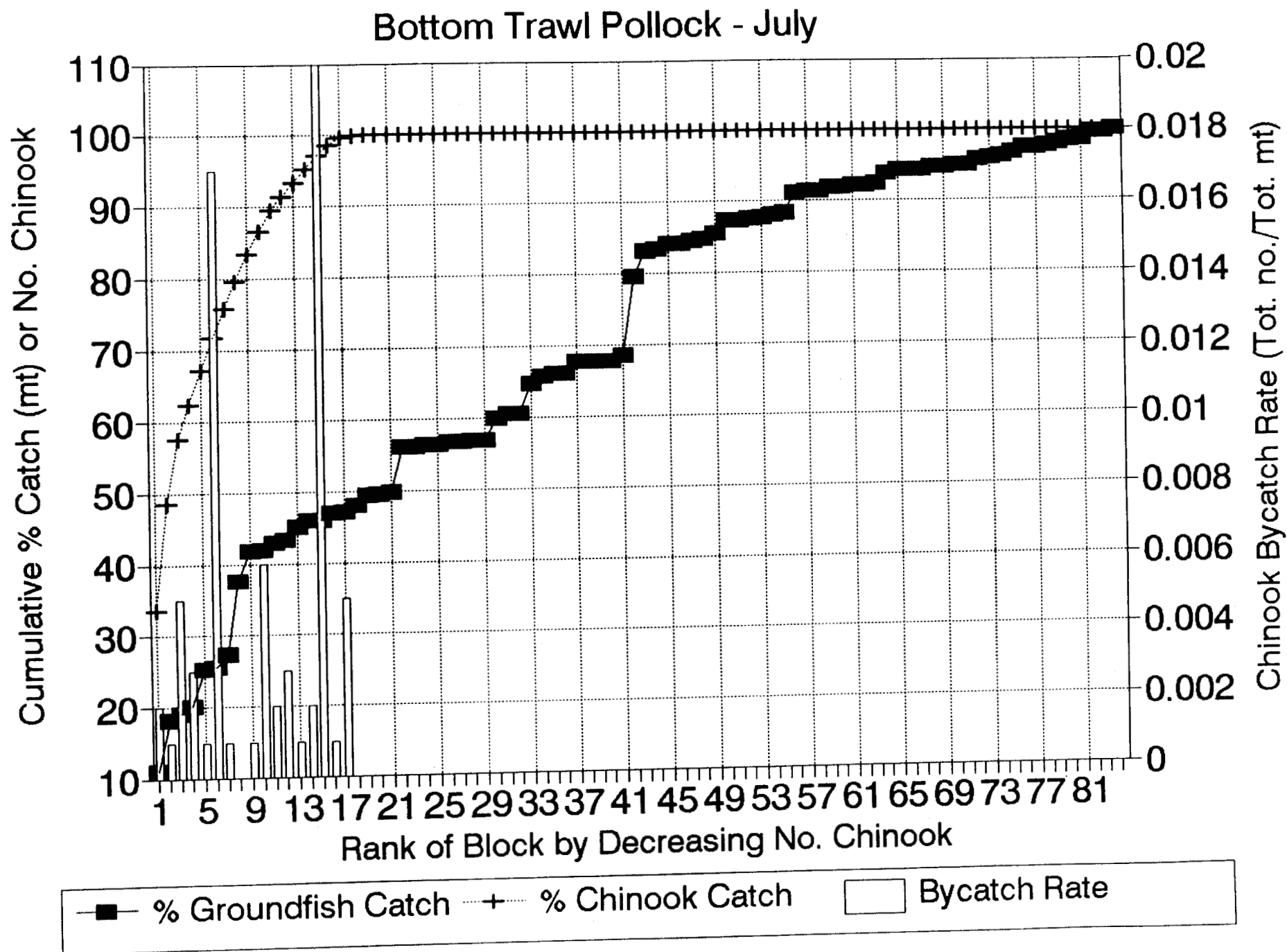
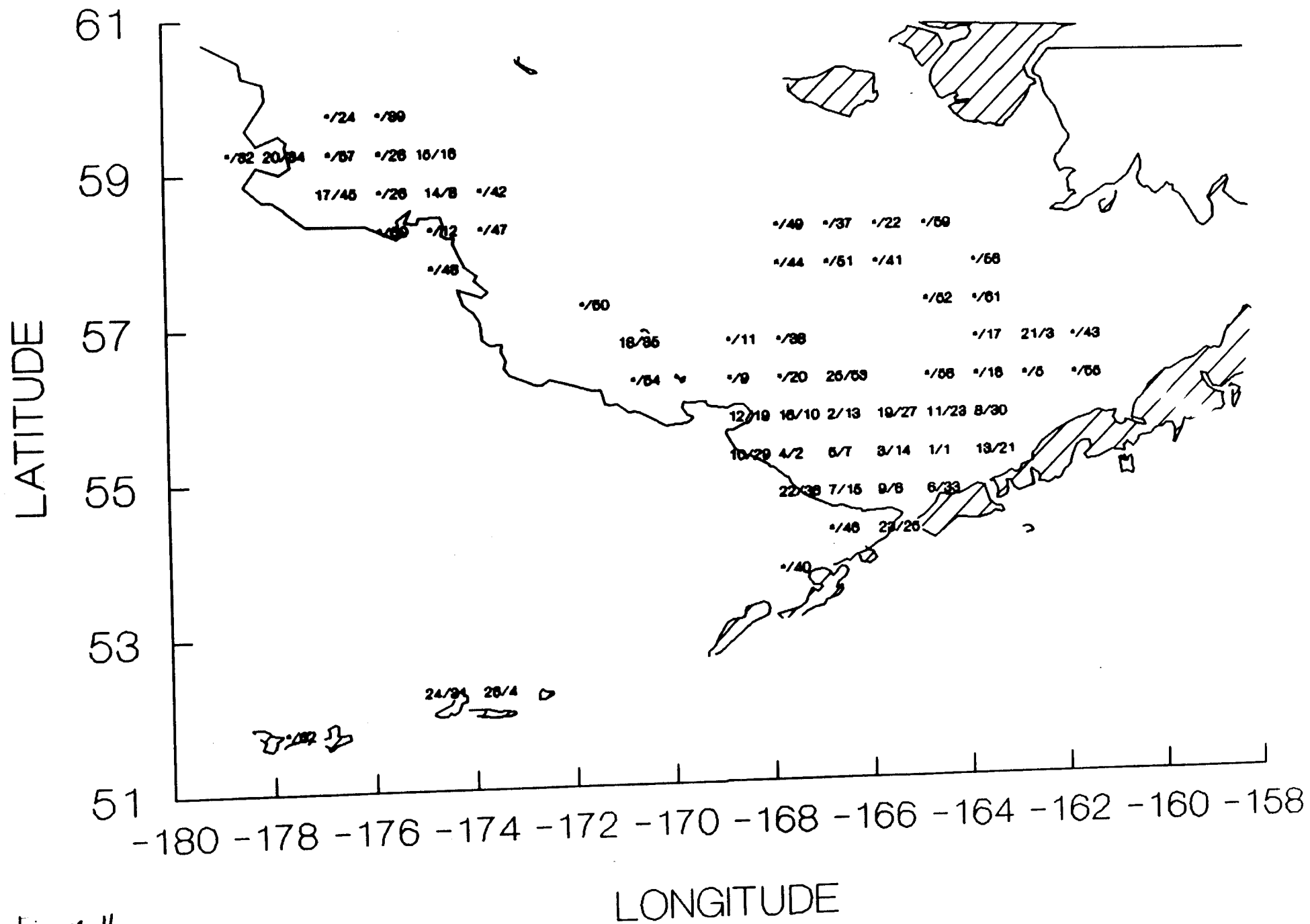


Figure 10 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the bottom trawl fishery for pollock during the month of July.

August. 1980 - 1989. Mean King/Mean Catch. Bottom Trawl Pollock



August. 1980 - 1989. Bycatch Rate. Bottom Trawl Pollock

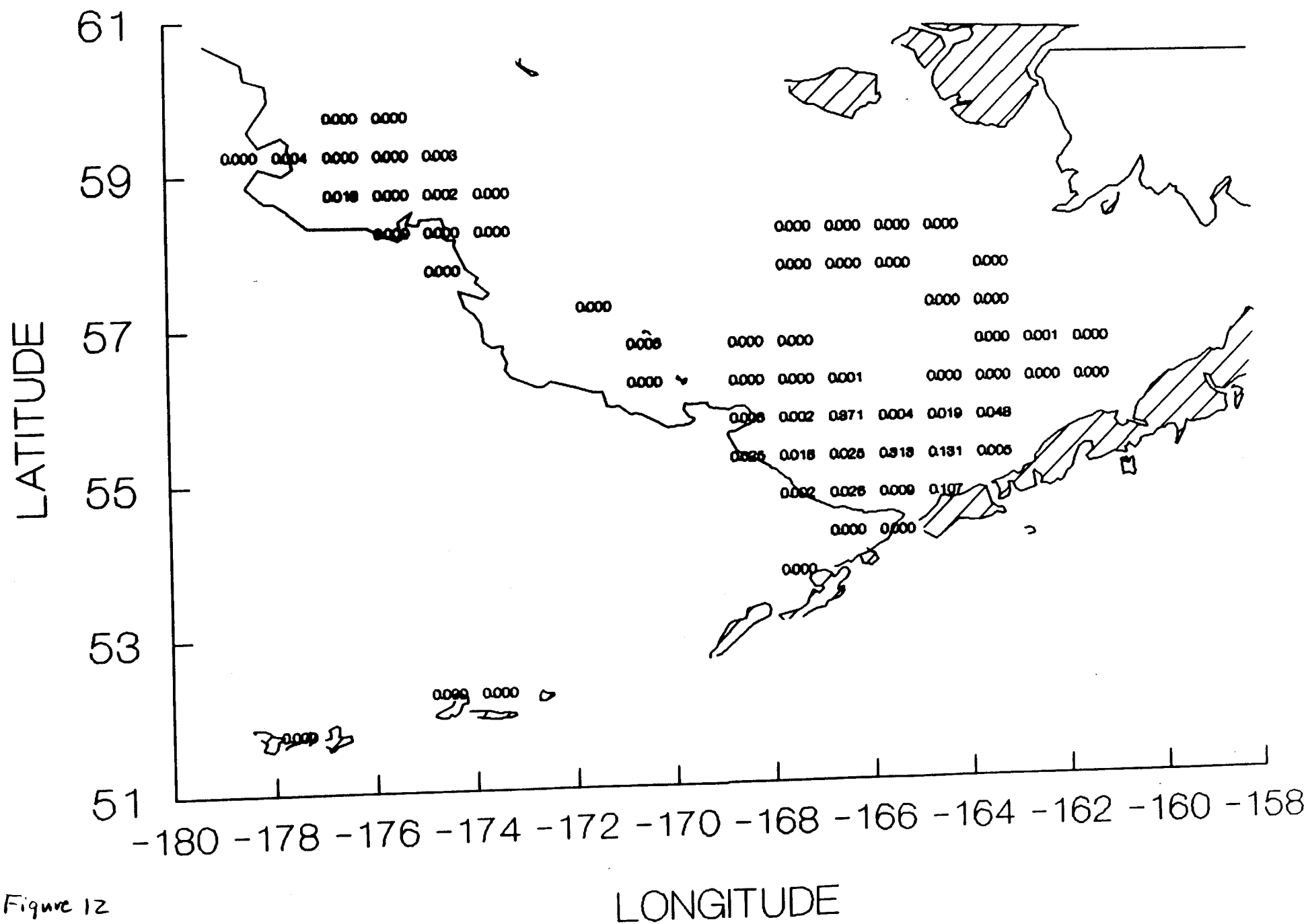


Figure 12

Bottom Trawl Pollock - August

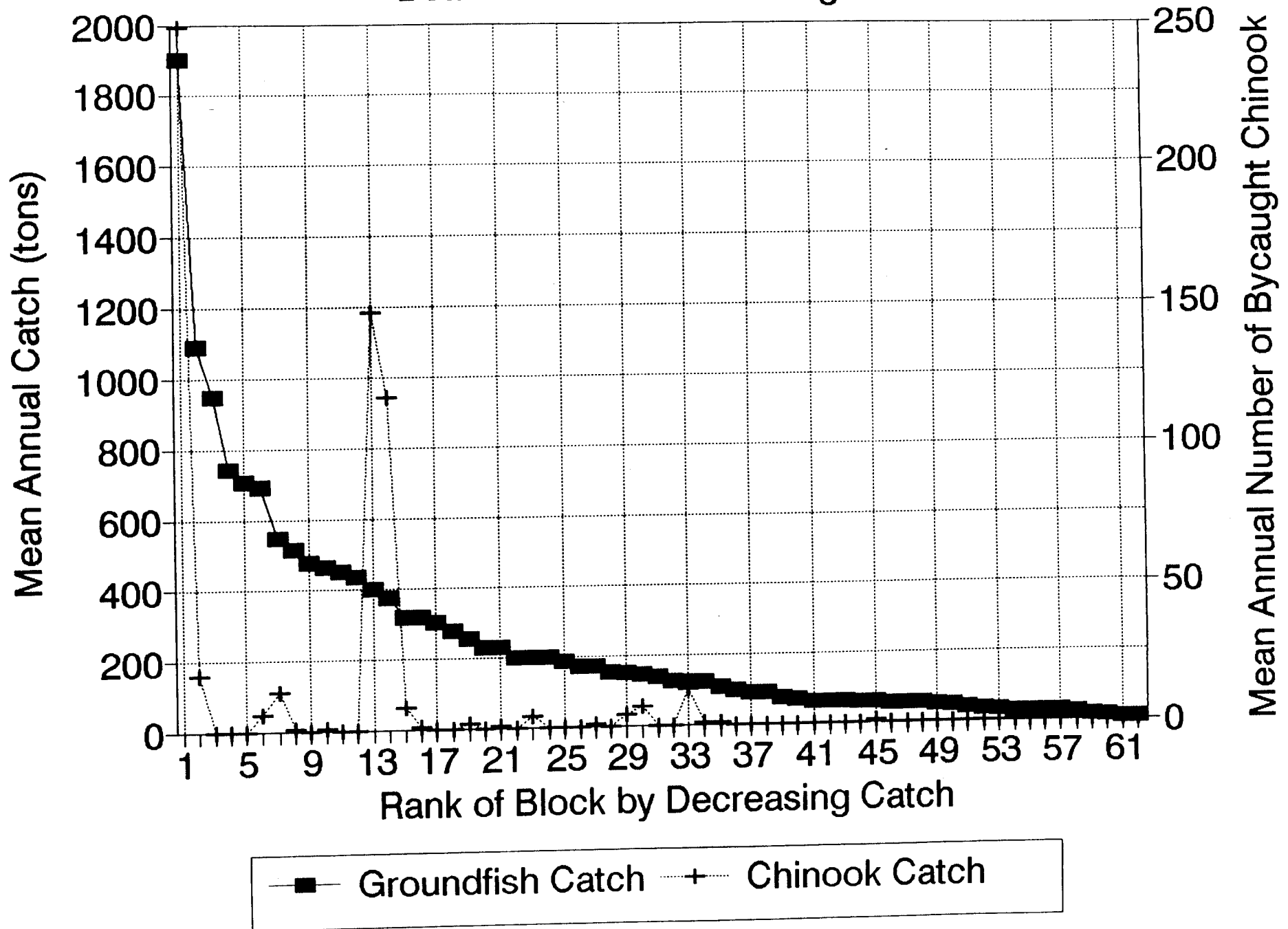


Figure 13 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the bottom trawl fishery for pollock during the month of August.

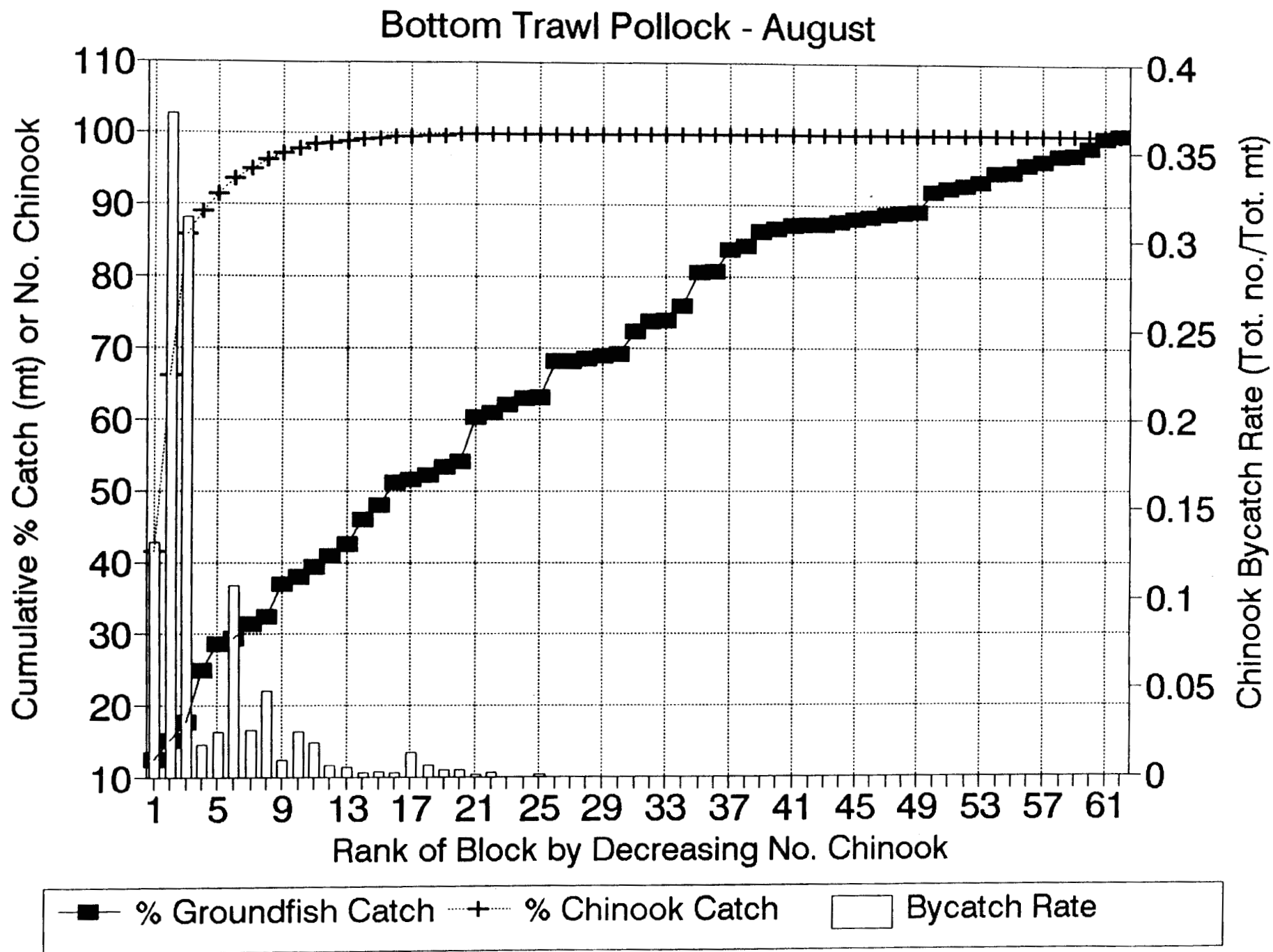
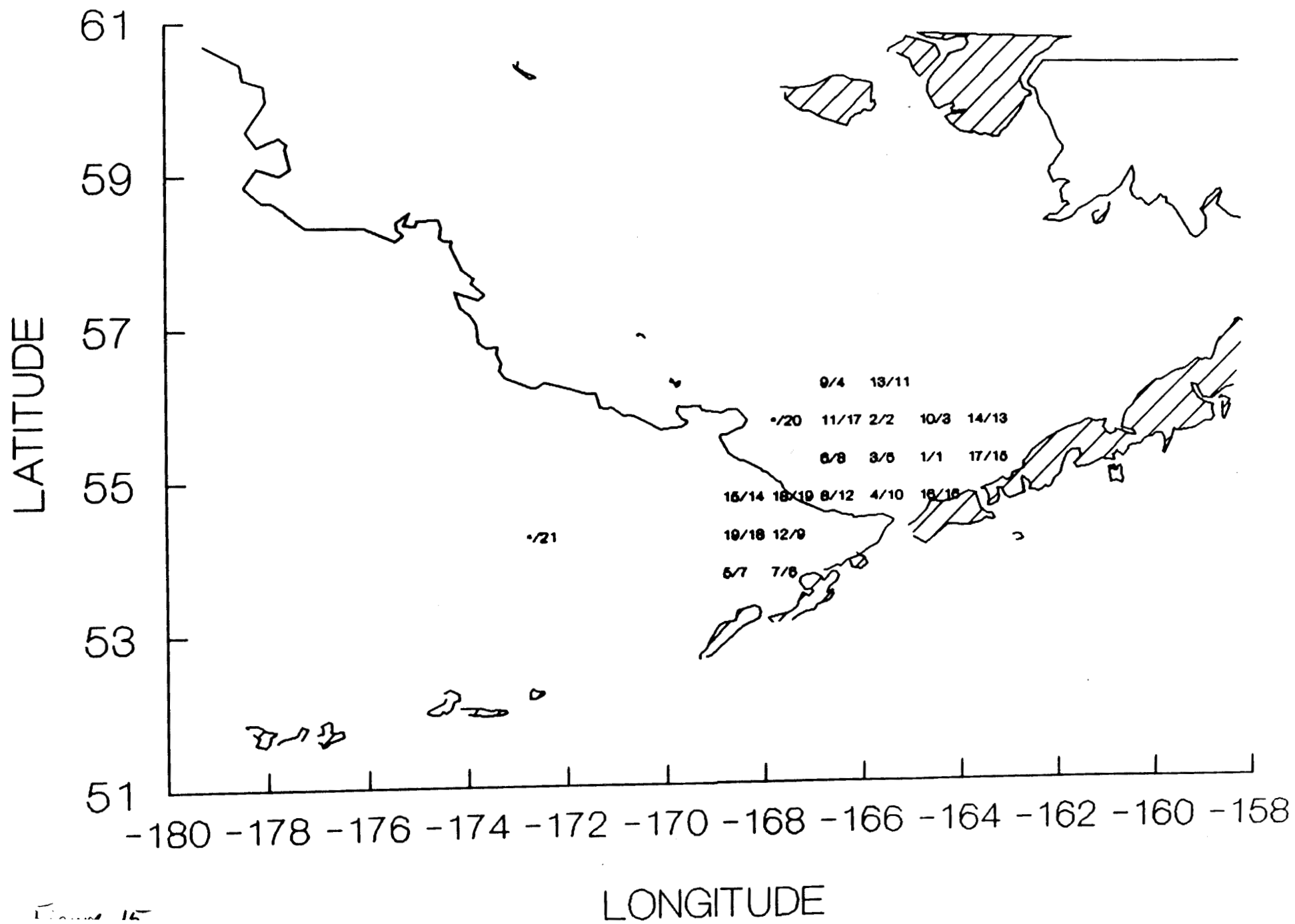


Figure 14 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the bottom trawl fishery for pollock during the month of August. Sample sizes for each block are indicated by histograms.

January, 1980 - 1989, Mean King/Mean Catch, Pelagic Trawl Pollock



January, 1980 - 1989. Bycatch Rate. Pelagic Trawl Pollock

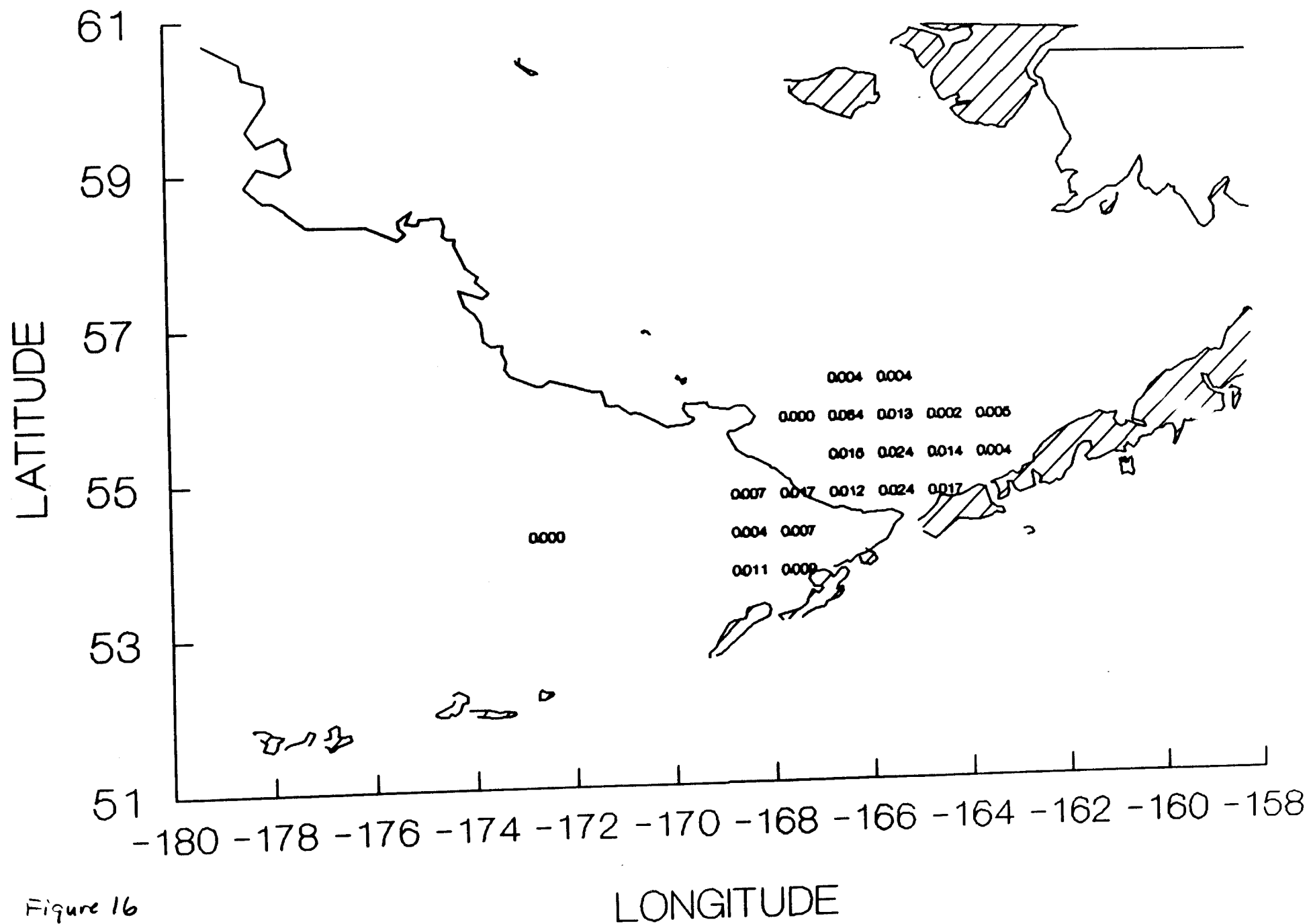


Figure 16

Pelagic Trawl Pollock - January

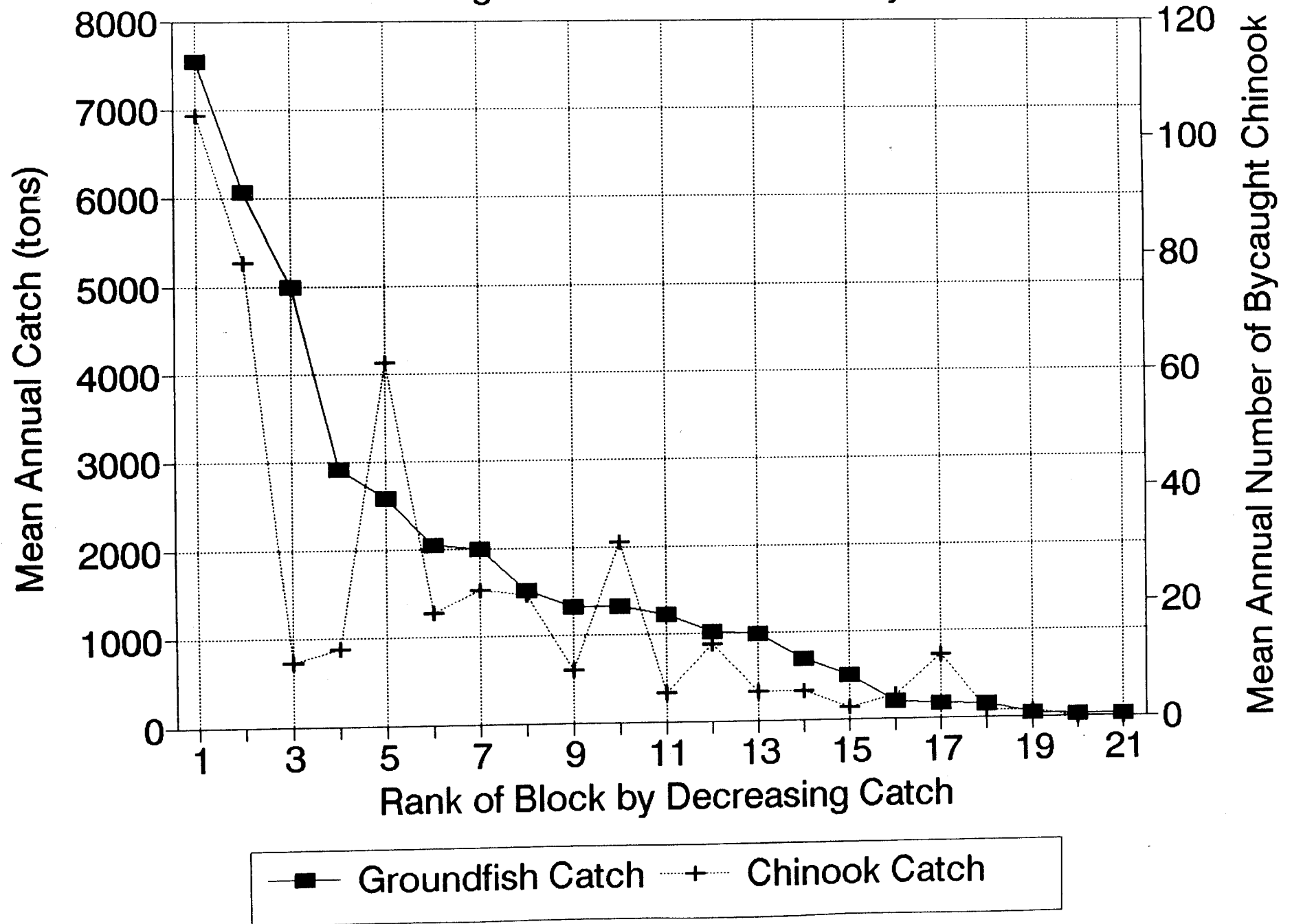
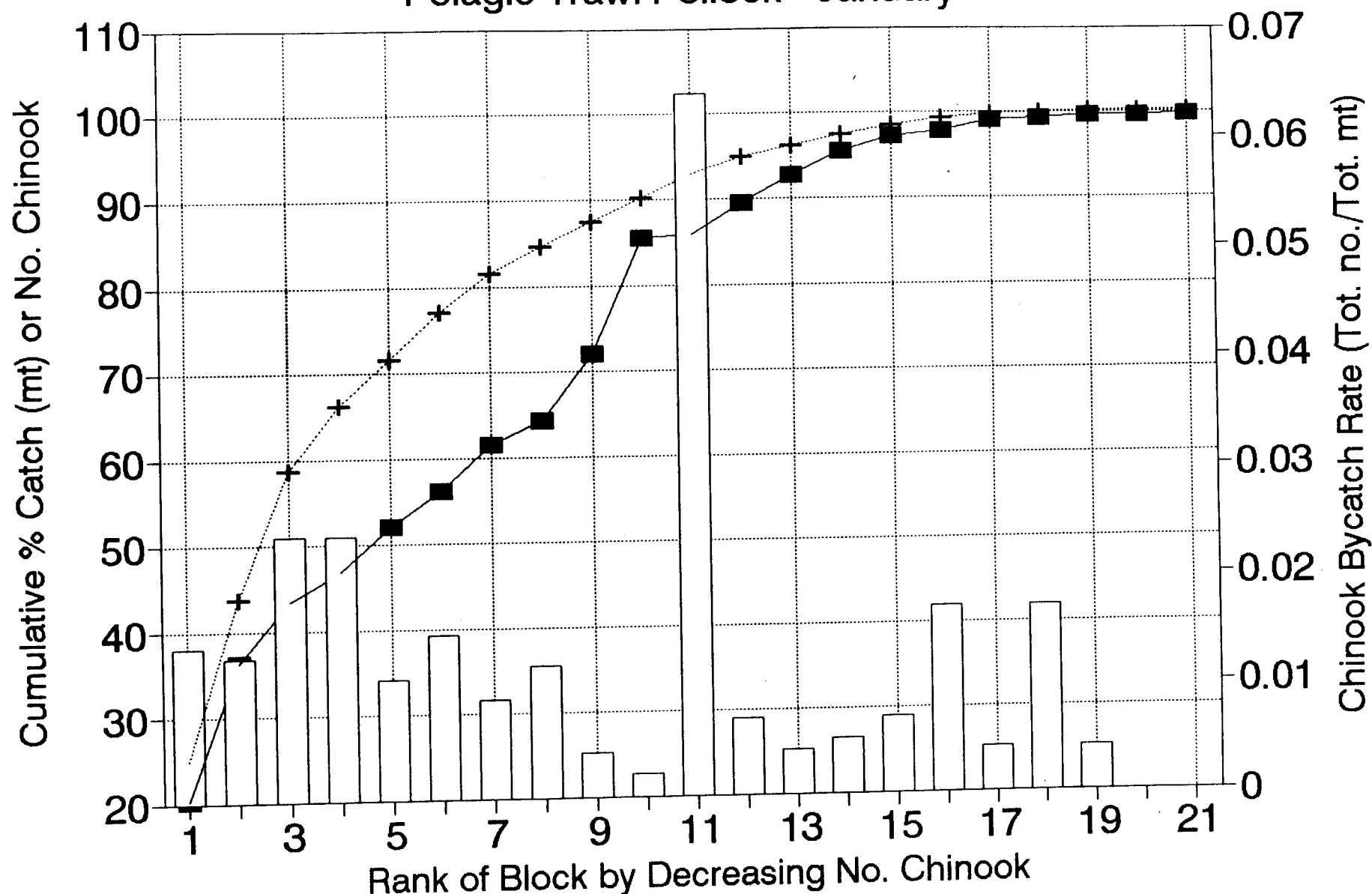


Figure 17 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the pelagic trawl fishery for pollock during January.

Pelagic Trawl Pollock - January



■ % Groundfish Catch
 + % Chinook Catch
 □ Bycatch Rate

Figure 18 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the pelagic trawl fishery for pollock during the month of January. Bycatch rates for each block are indicated by histograms.

February, 1980 - 1989. Mean King/Mean Catch. Pelagic Trawl Pollock

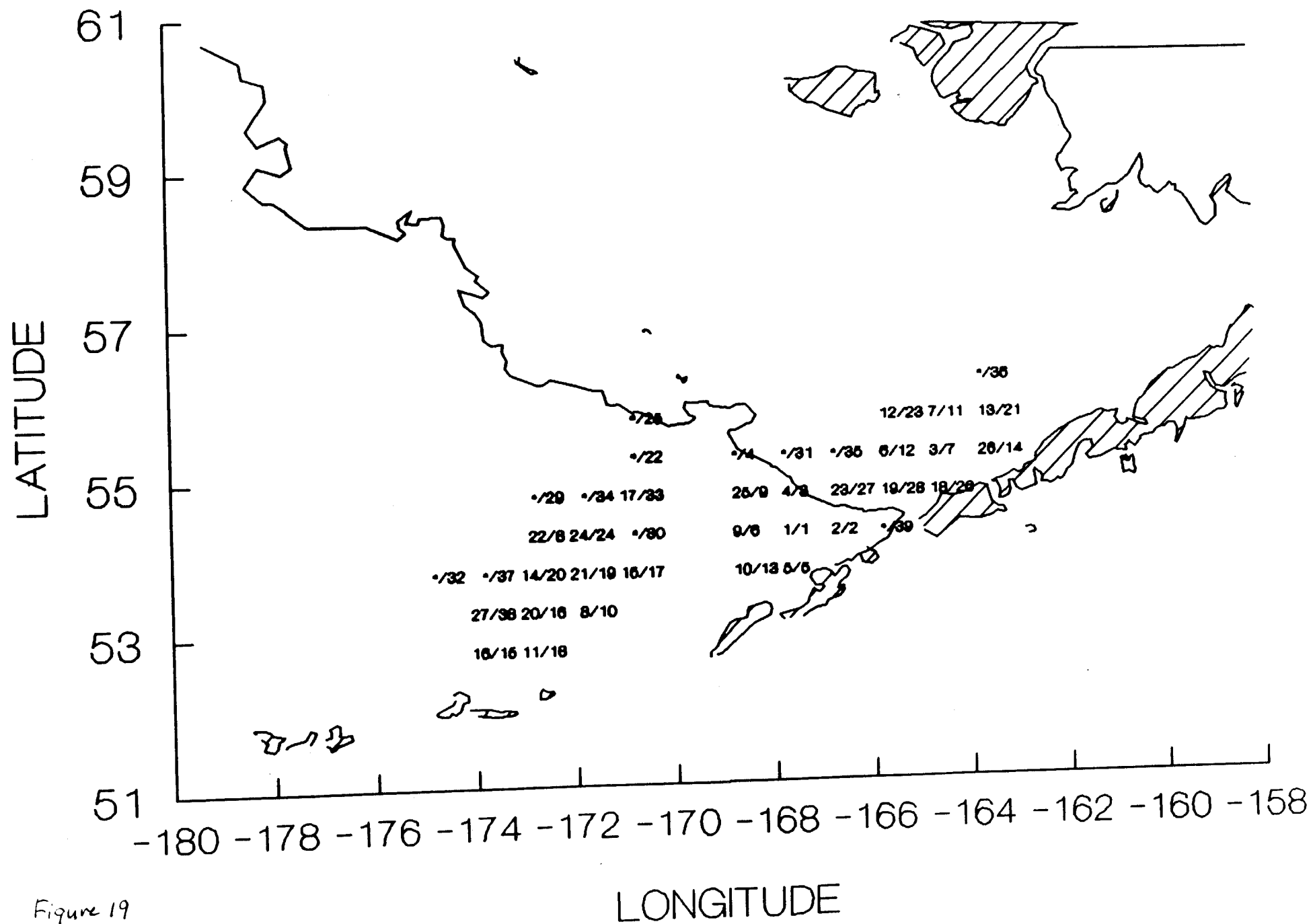


Figure 19

Pelagic Trawl Pollock - February

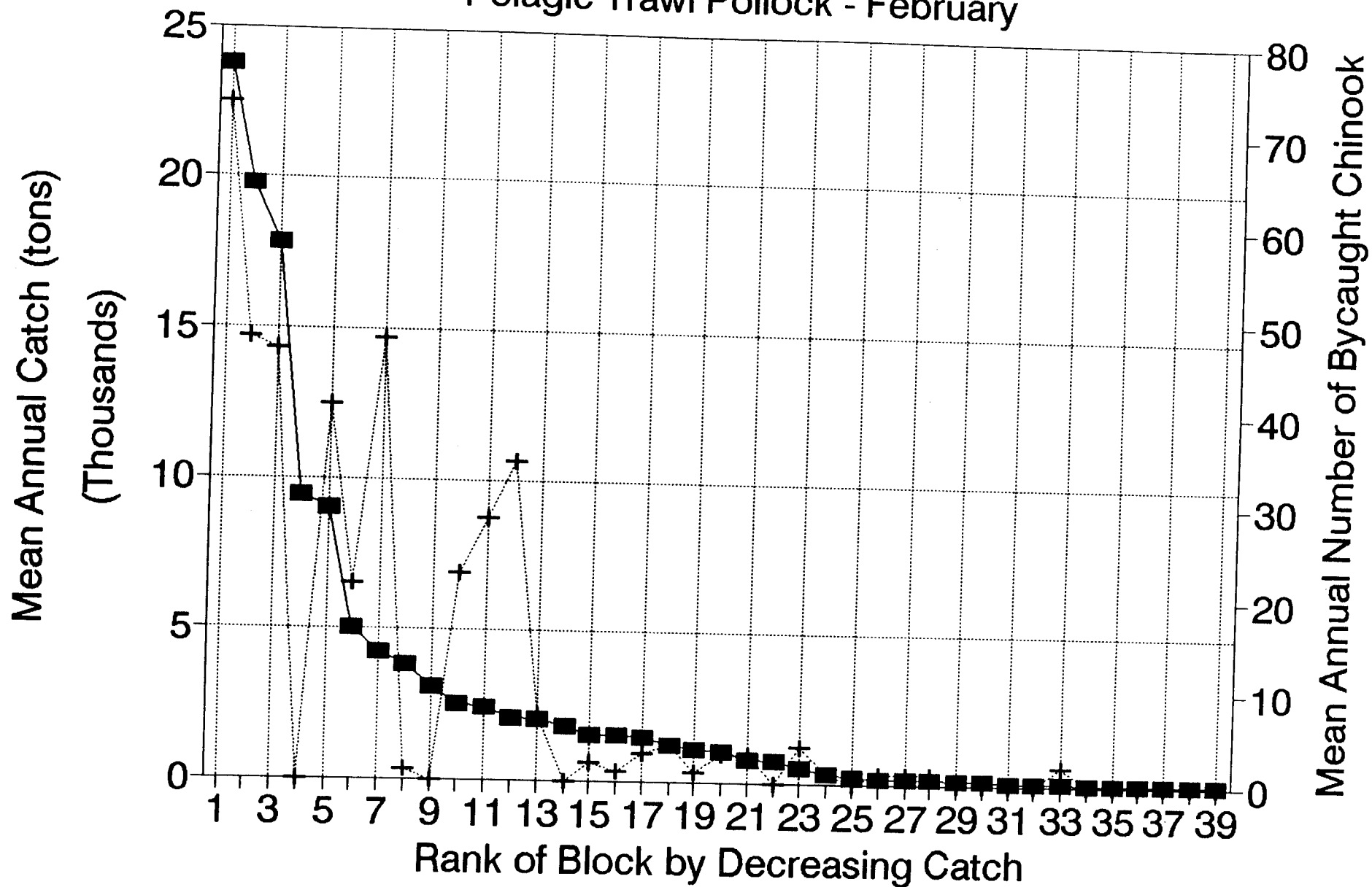


Figure 20 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the pelagic trawl fishery for pollock during the month of February.

Pelagic Trawl Pollock - February

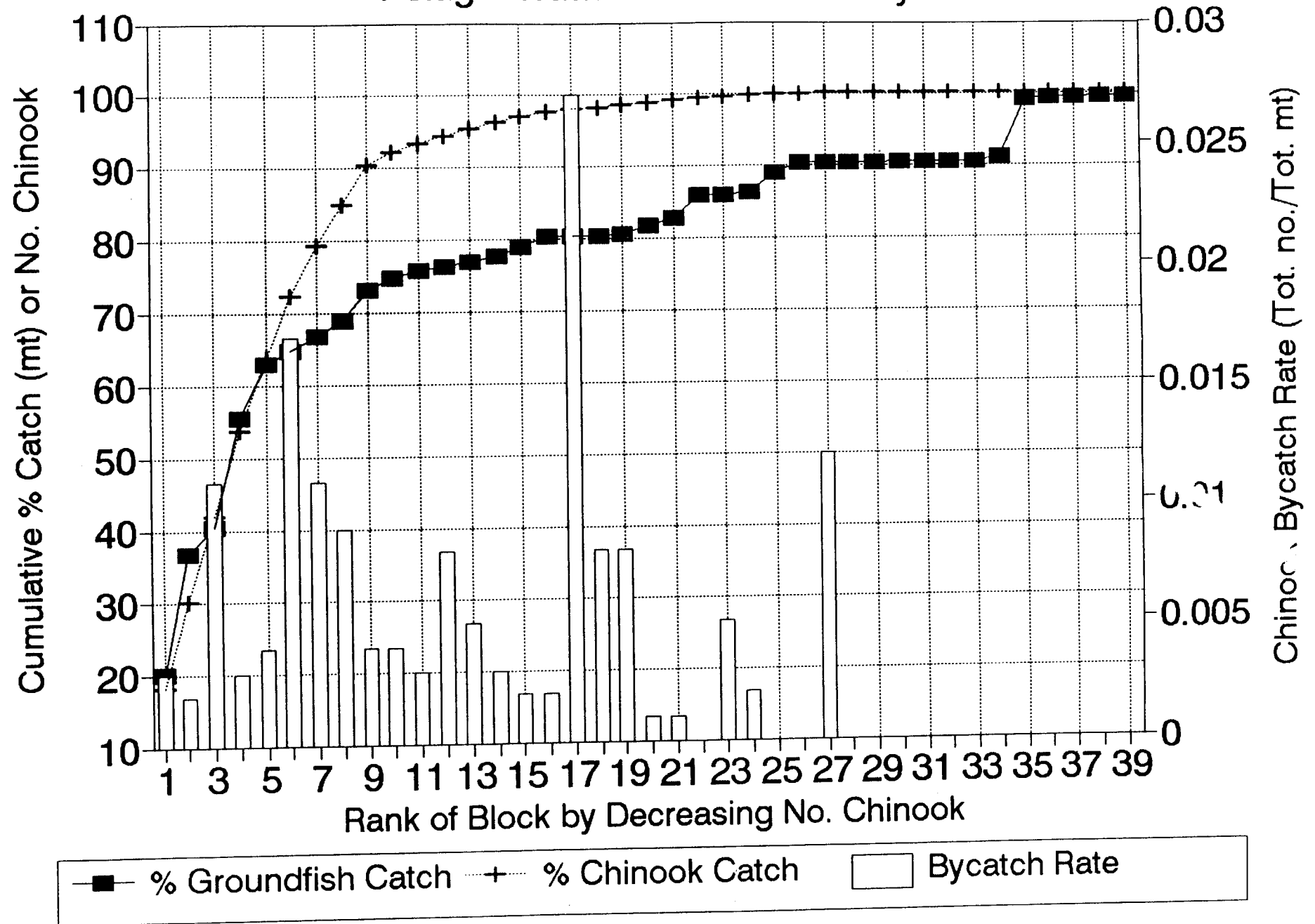


Figure 2/ One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the pelagic trawl fishery for pollock during the month of February. Bycatch rates for each block are indicated by histograms.

April, 1980 - 1989. Mean King/Mean Catch. Pelagic Trawl Pollock

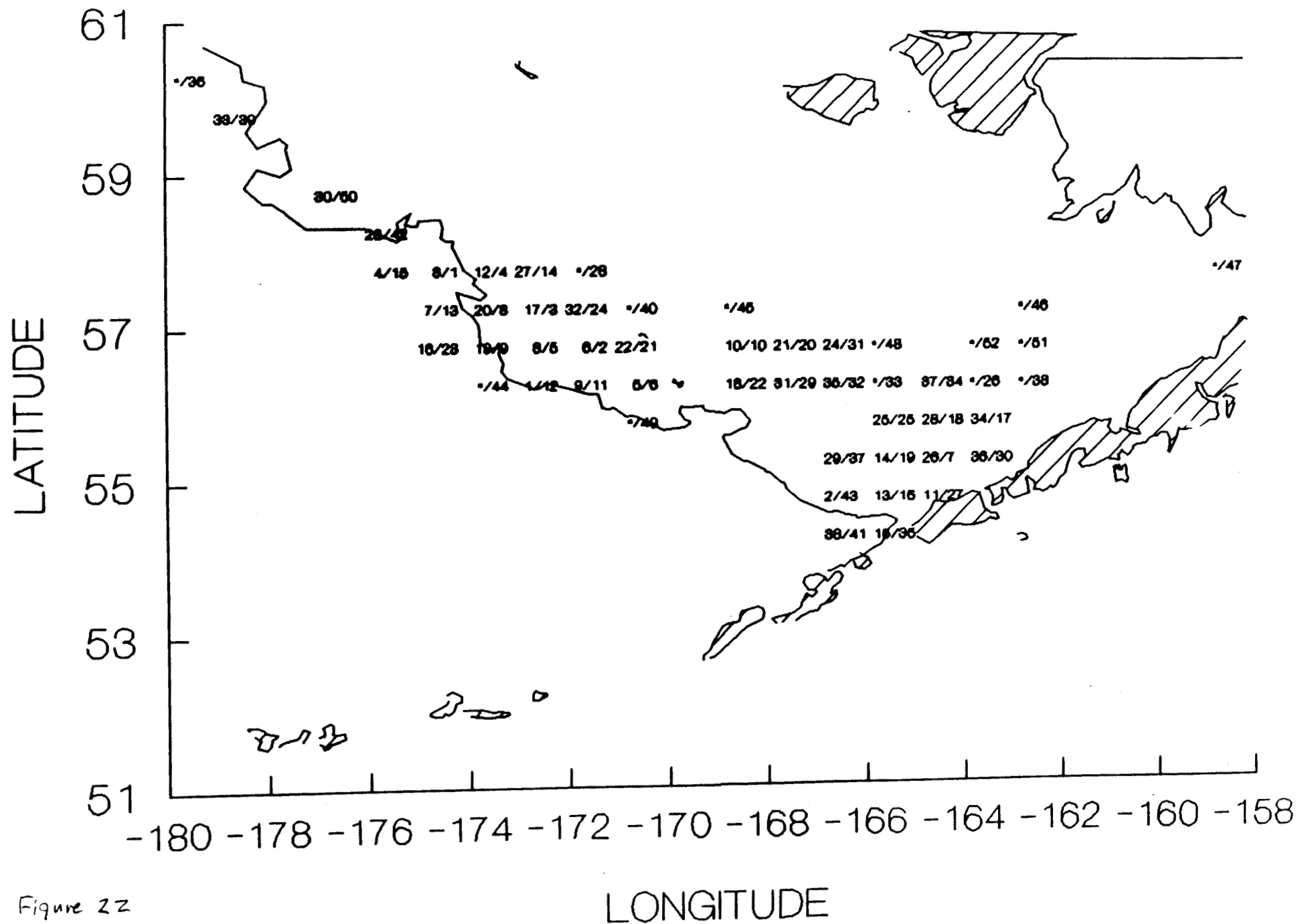


Figure 22

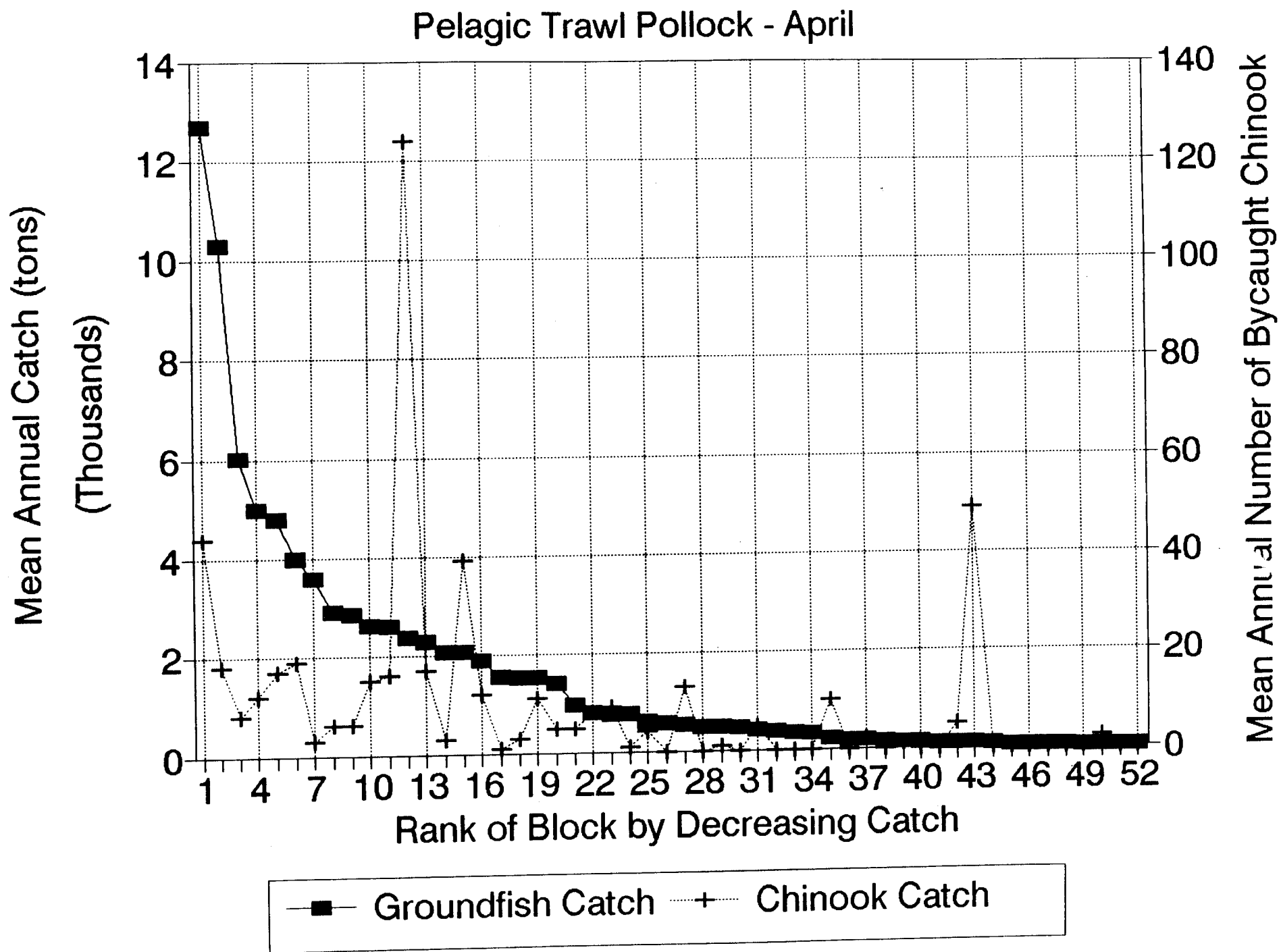


Figure 23 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the pelagic trawl fishery for pollock during the month of April.

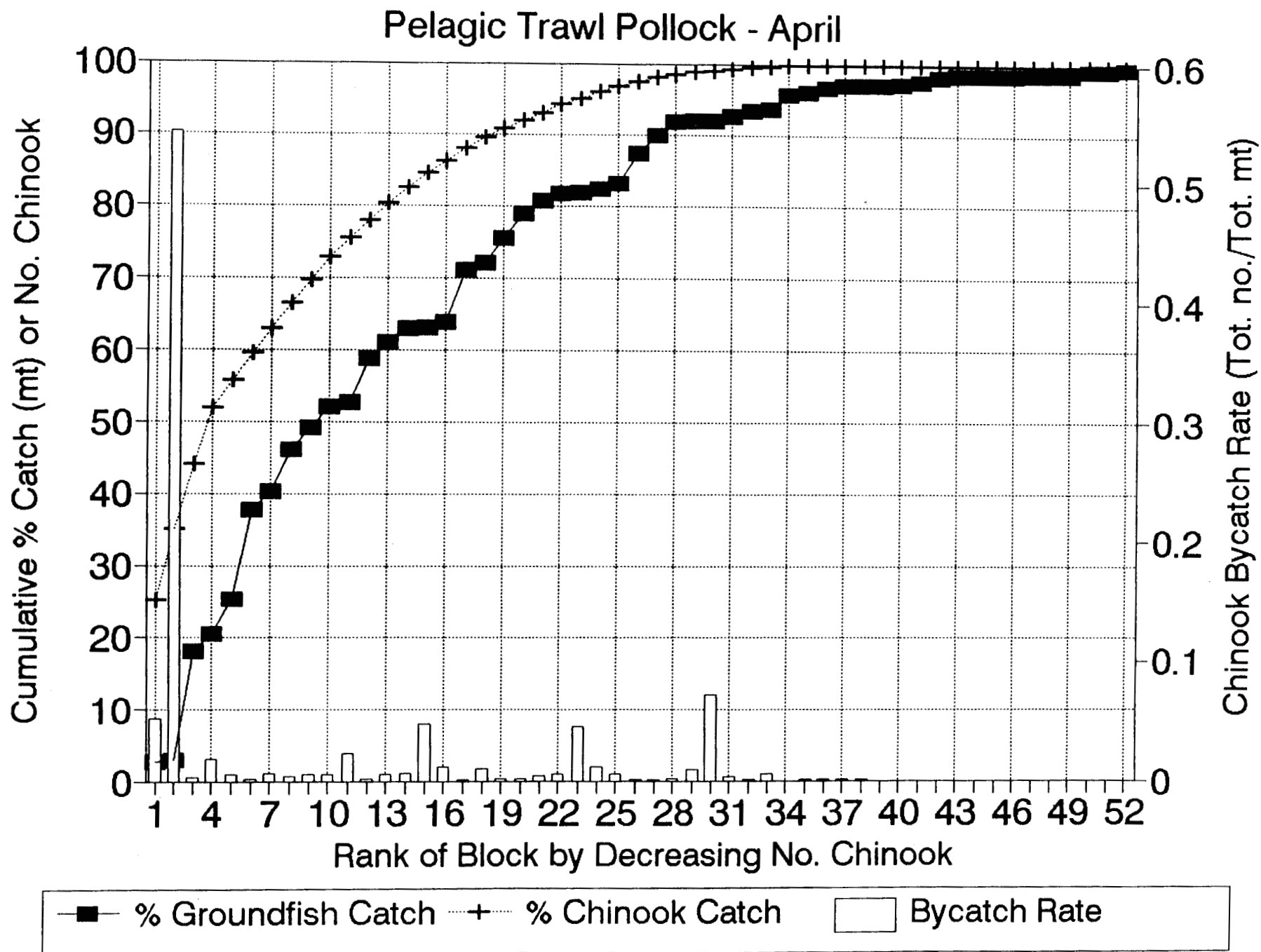


Figure 24 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the pelagic trawl fishery for pollock during the month of April. Bycatch rates for each block are indicated by histograms.

May, 1980 - 1989. Mean King/Mean Catch. Pelagic Trawl Pollock

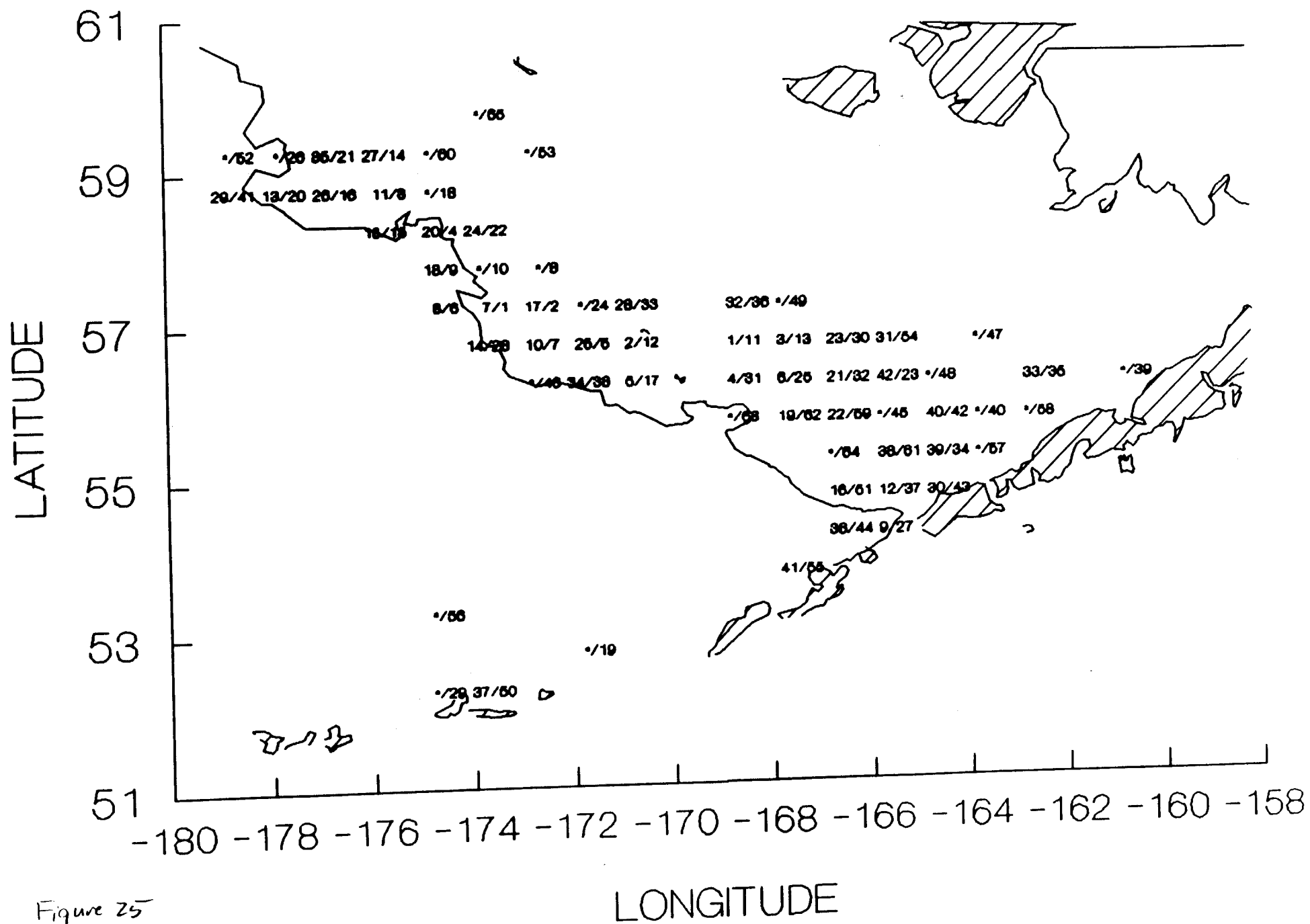


Figure 25

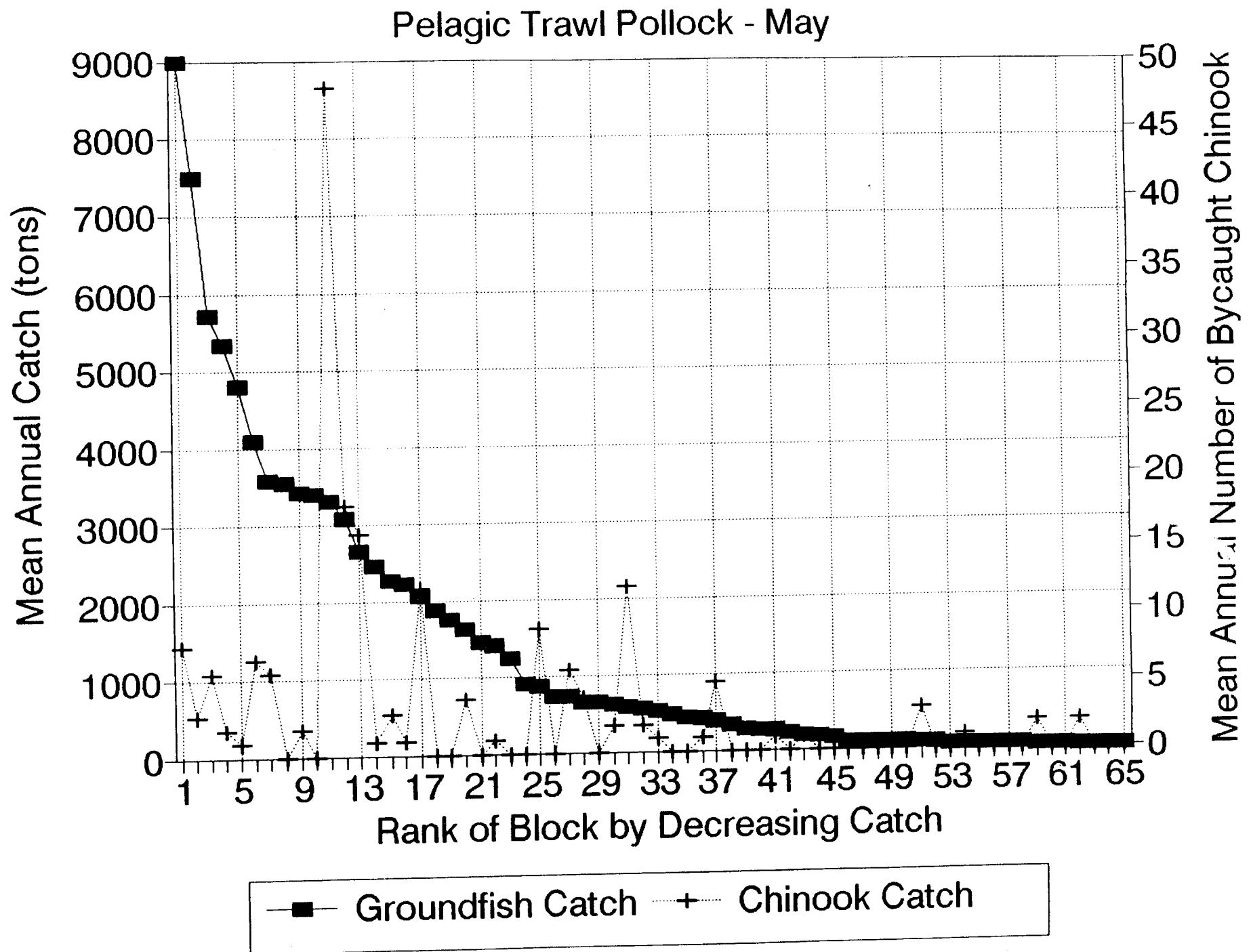


Figure 26 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the pelagic trawl fishery for pollock during the month of May.

Pelagic Trawl Pollock - May

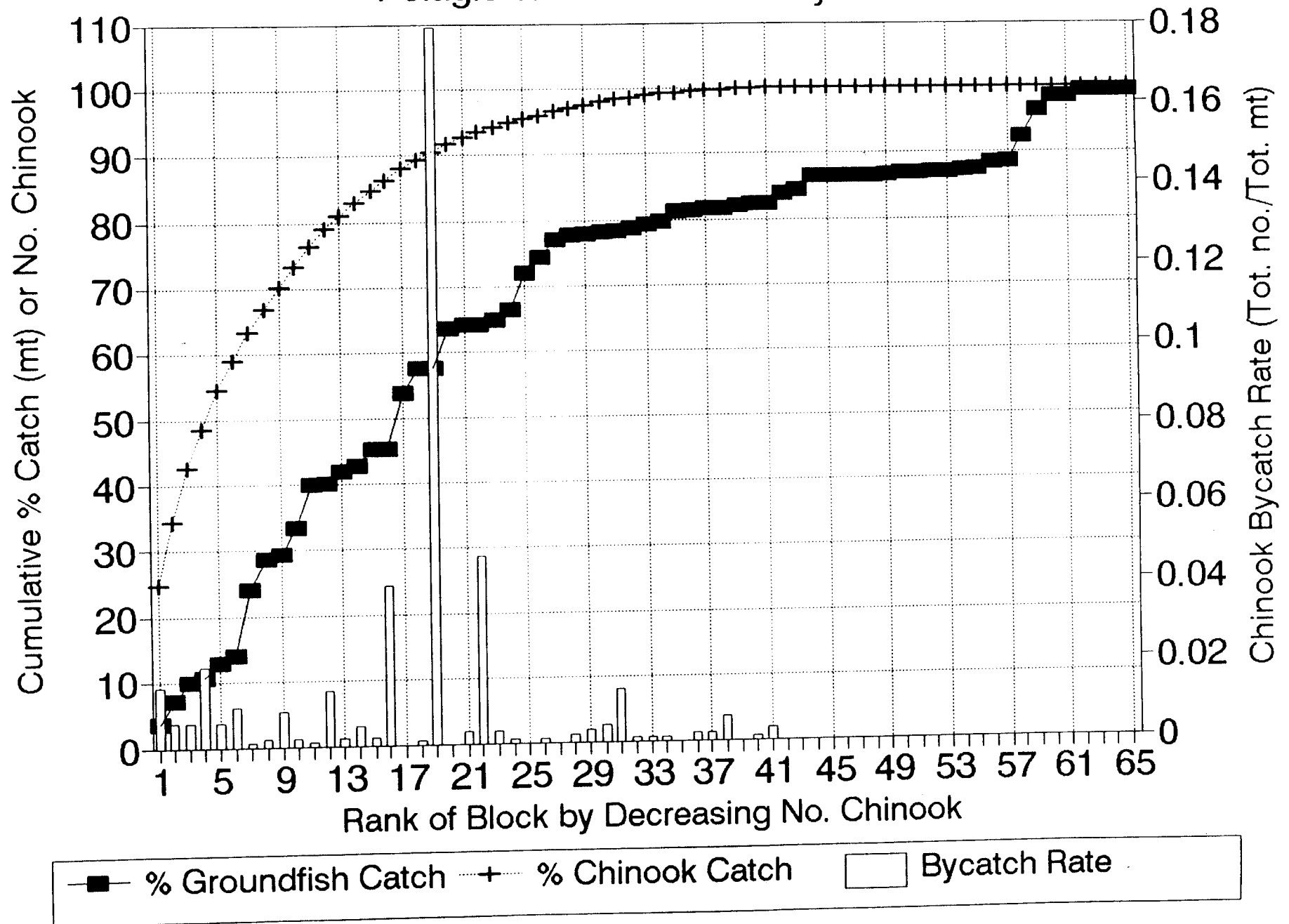


Figure 27 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the pelagic trawl fishery for pollock during the month of May. Bycatch rates for each block are indicated by histograms.

July, 1980 - 1989. Mean King/Mean Catch. Pelagic Trawl Pollock

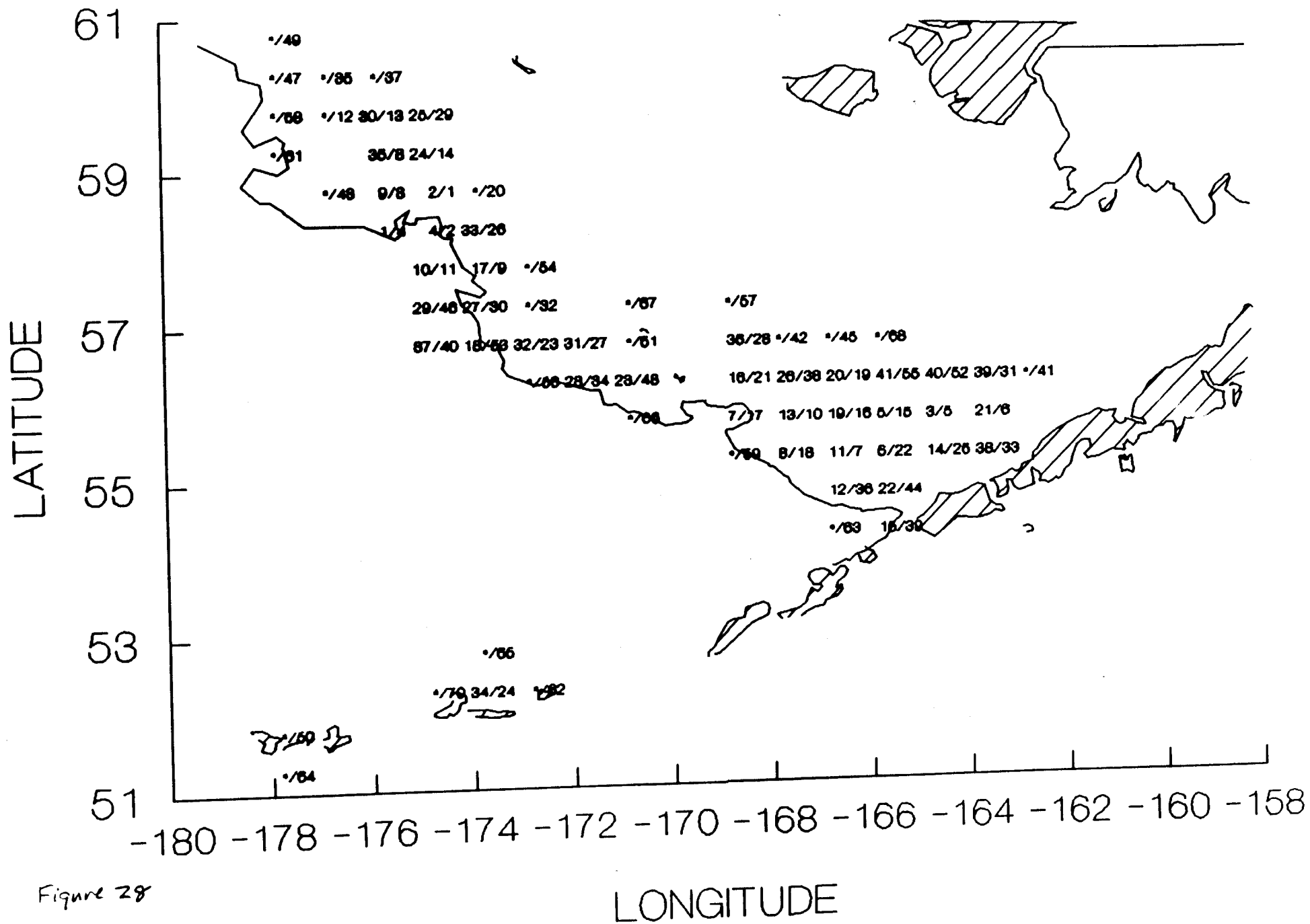


Figure 28

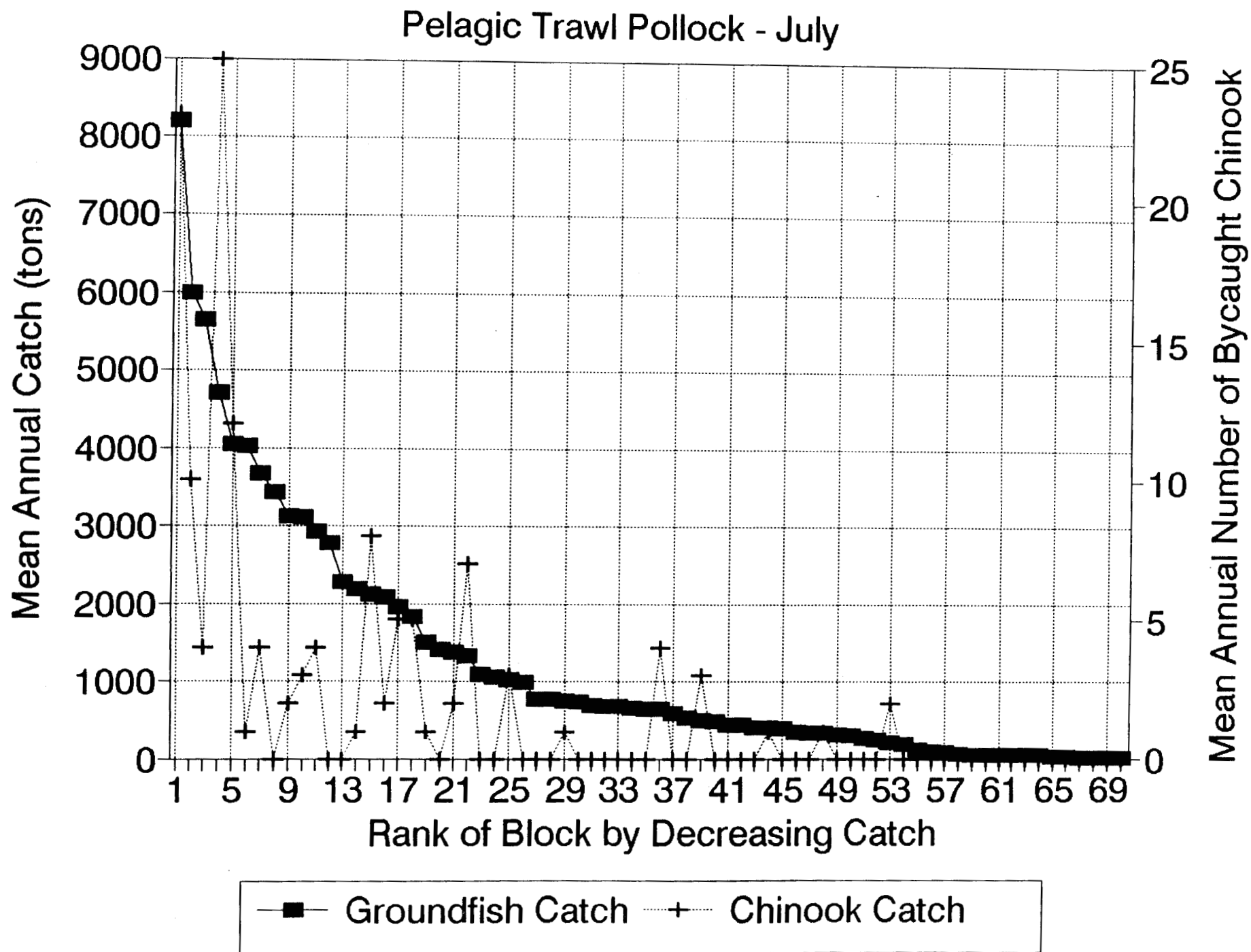


Figure 29 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the pelagic trawl fishery for pollock during the month of July.

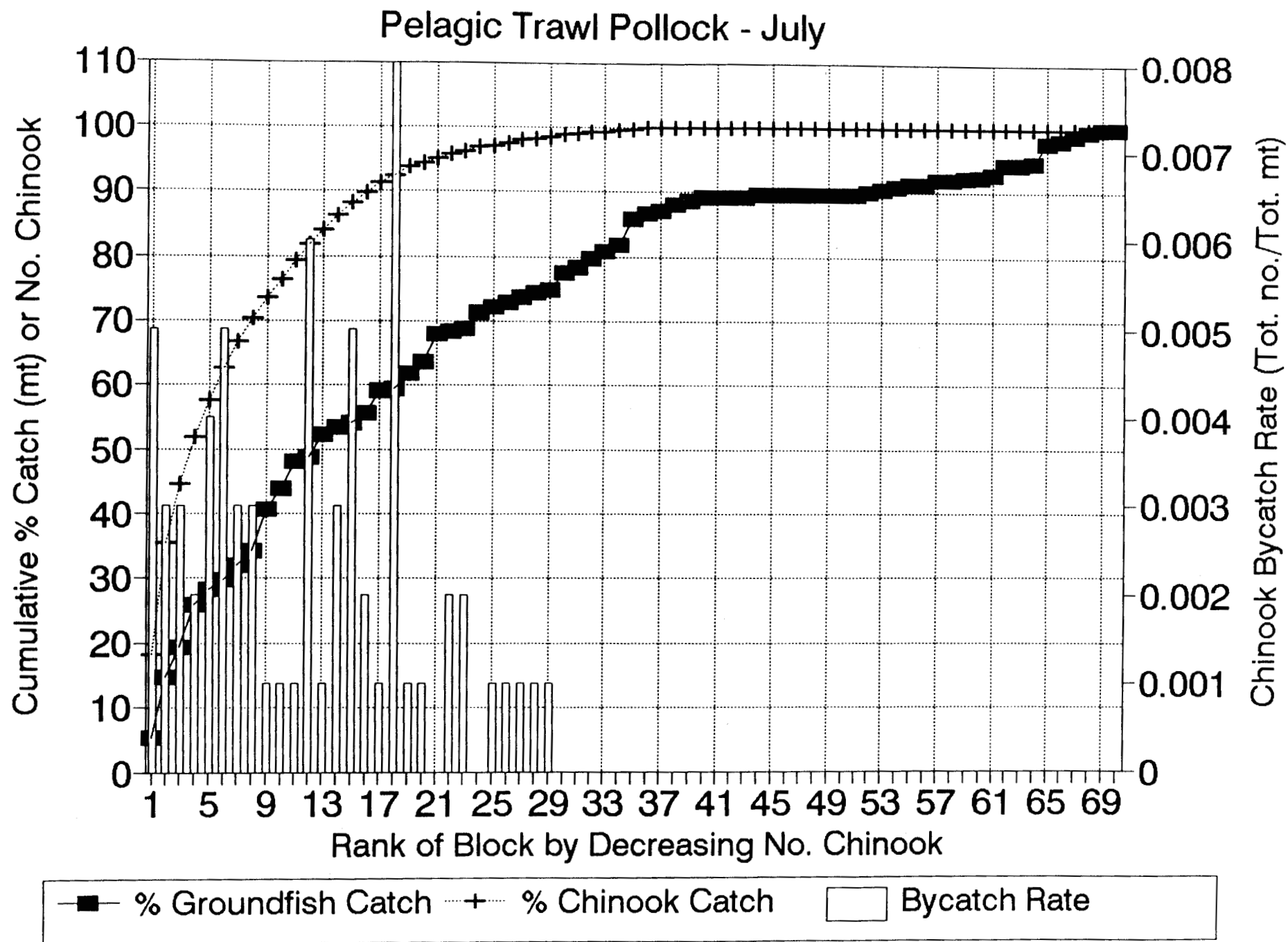
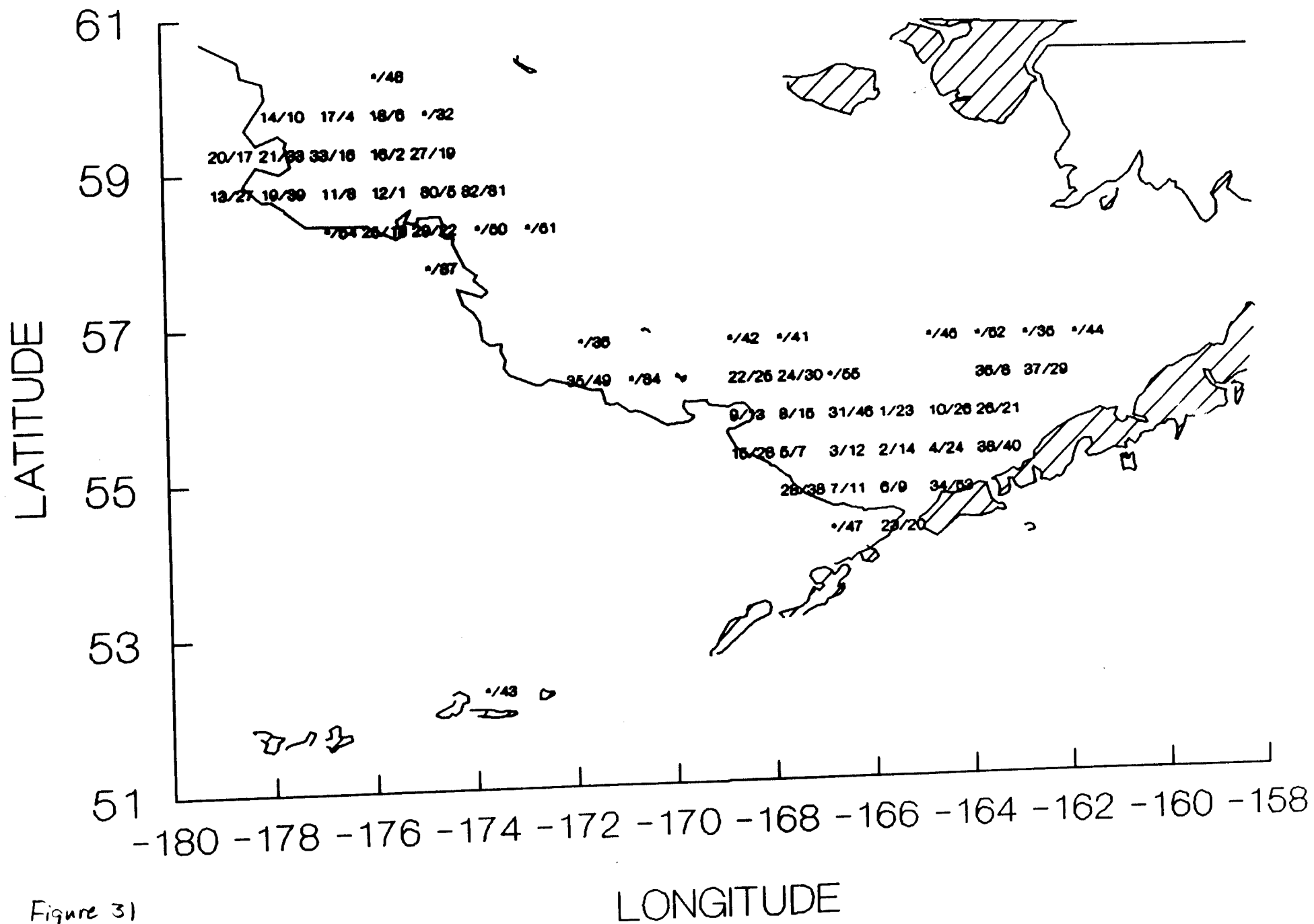


Figure 30 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the pelagic trawl fishery for pollock during the month of July. Bycatch rates for each block are indicated by histograms.

August, 1980 - 1989. Mean King/Mean Catch. Pelagic Trawl Pollock



August, 1980 - 1989. Bycatch Rate, Pelagic Trawl Pollock

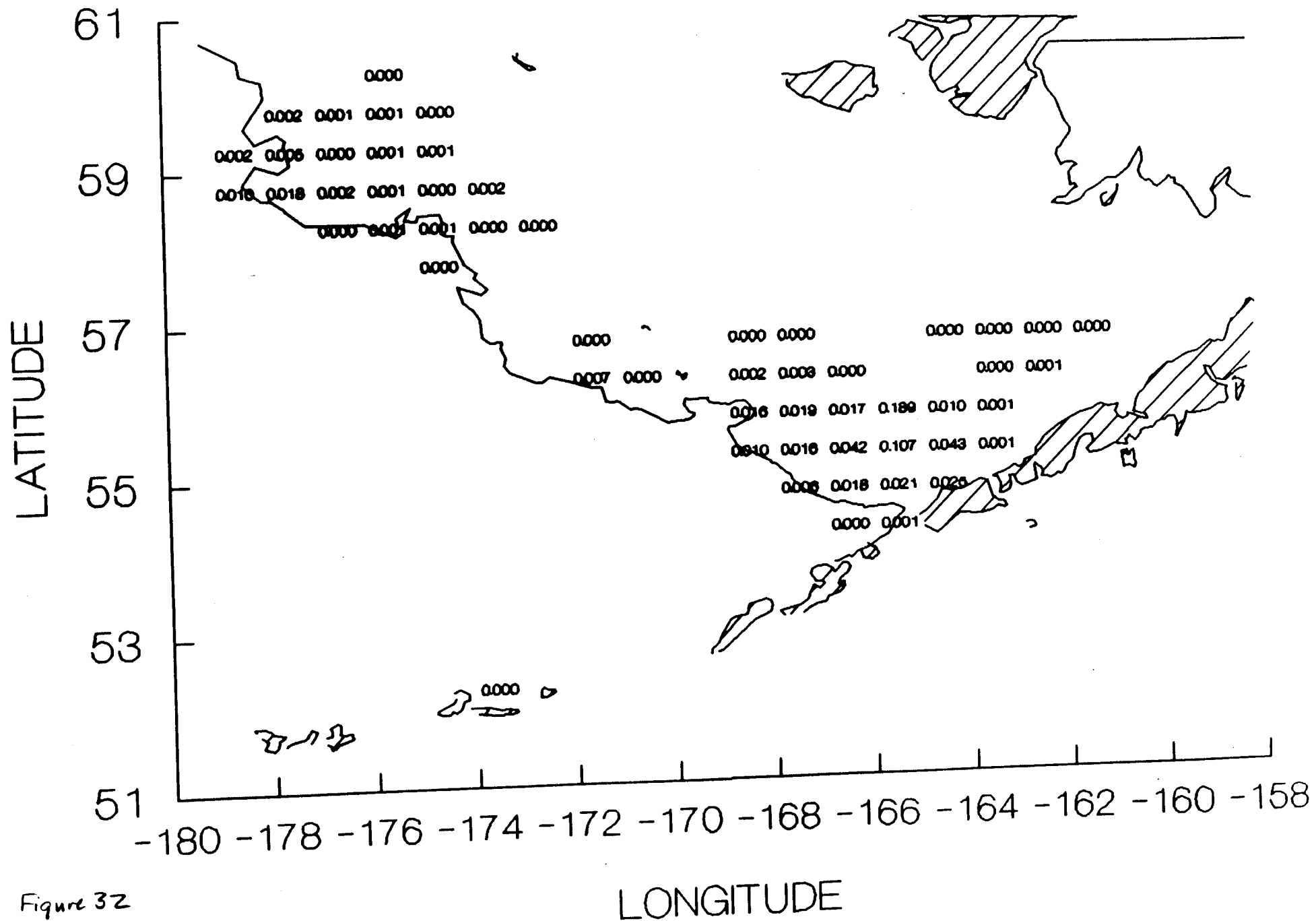


Figure 32

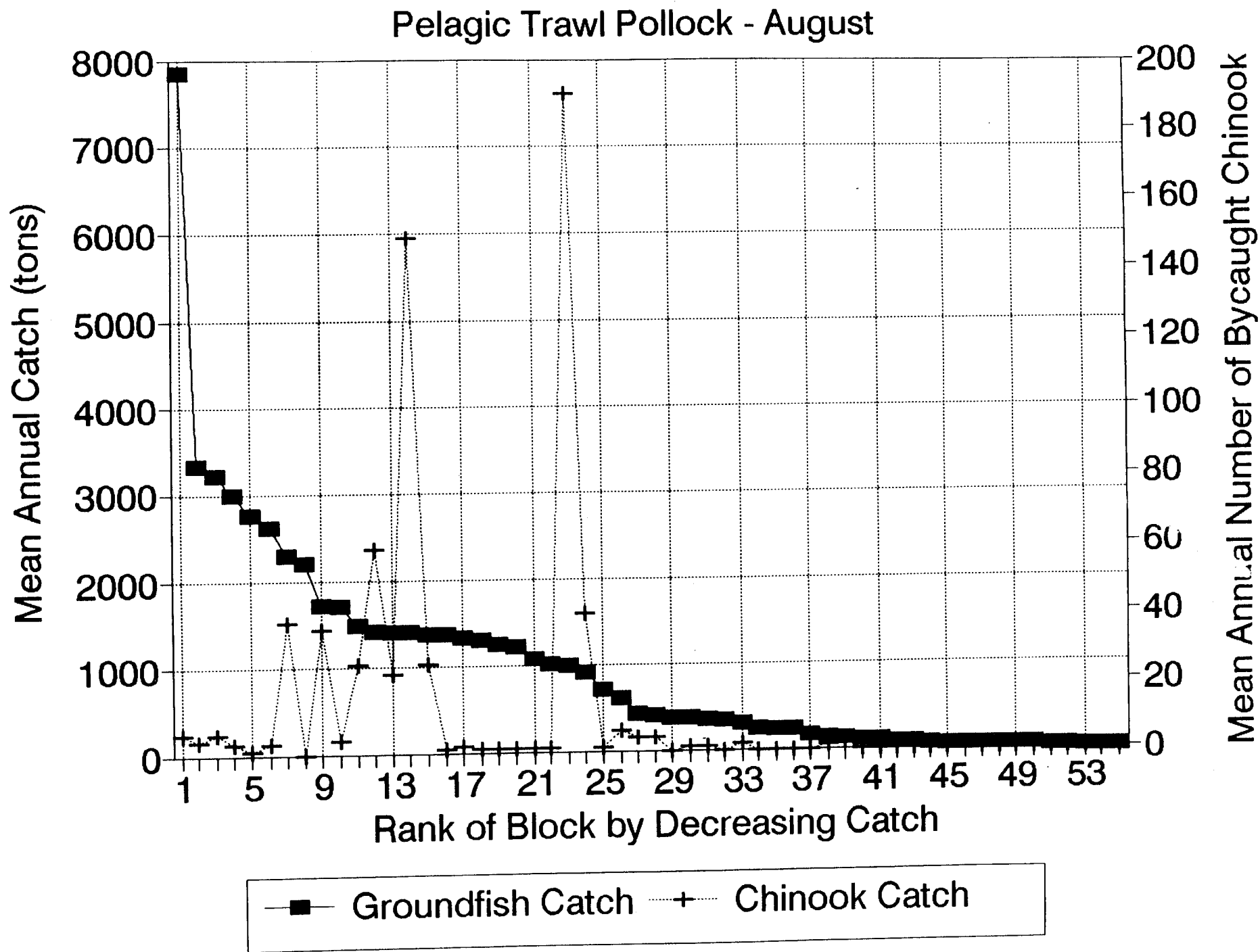


Figure 33 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the pelagic trawl fishery for pollock during the month of August.

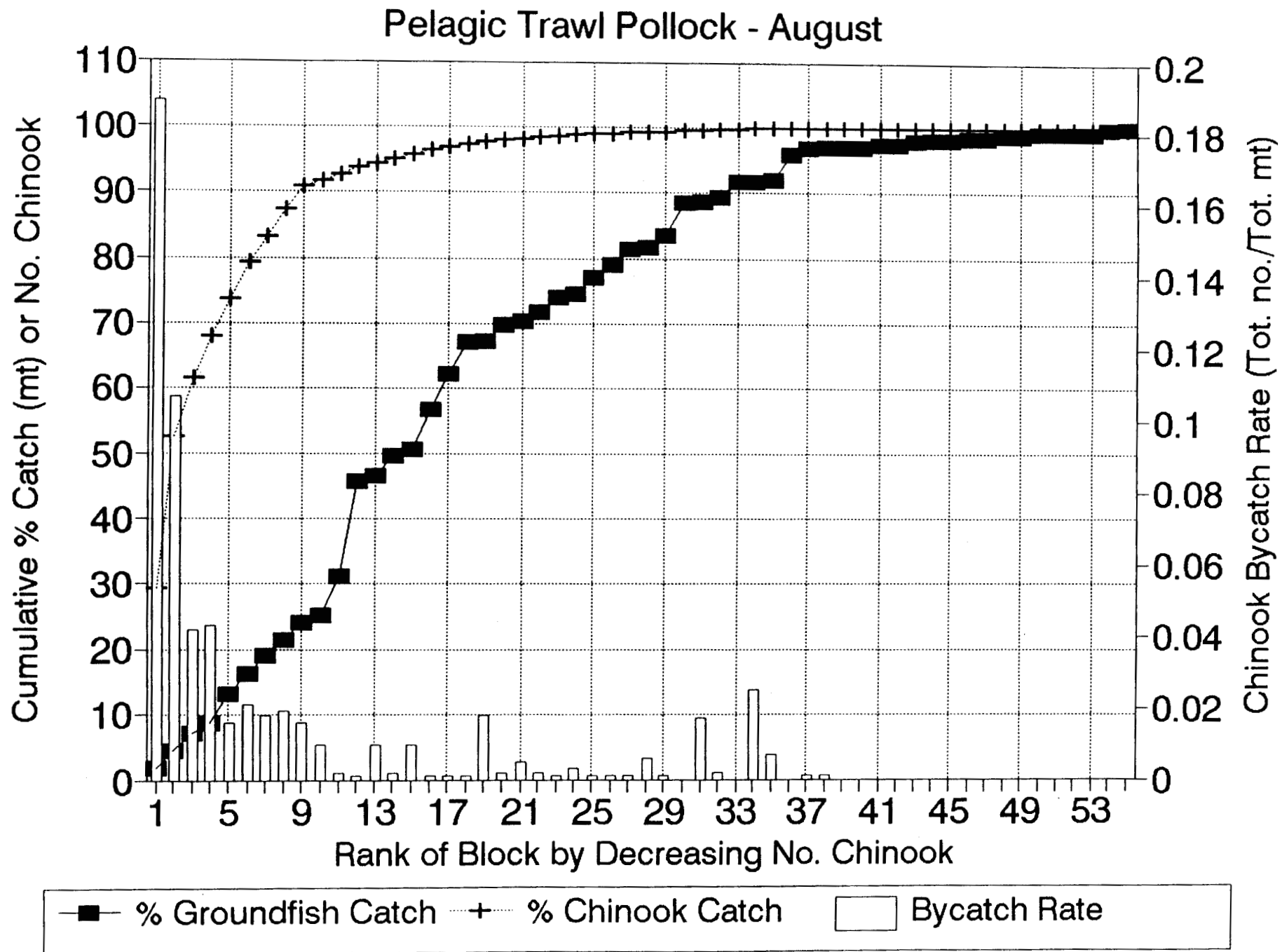


Figure 34 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the pelagic trawl fishery for pollock during the month of August. Sample sizes for each block are indicated by histograms.

January, 1980 - 1989. Mean King/Mean Catch Ratio. Bottom Trawl Cod

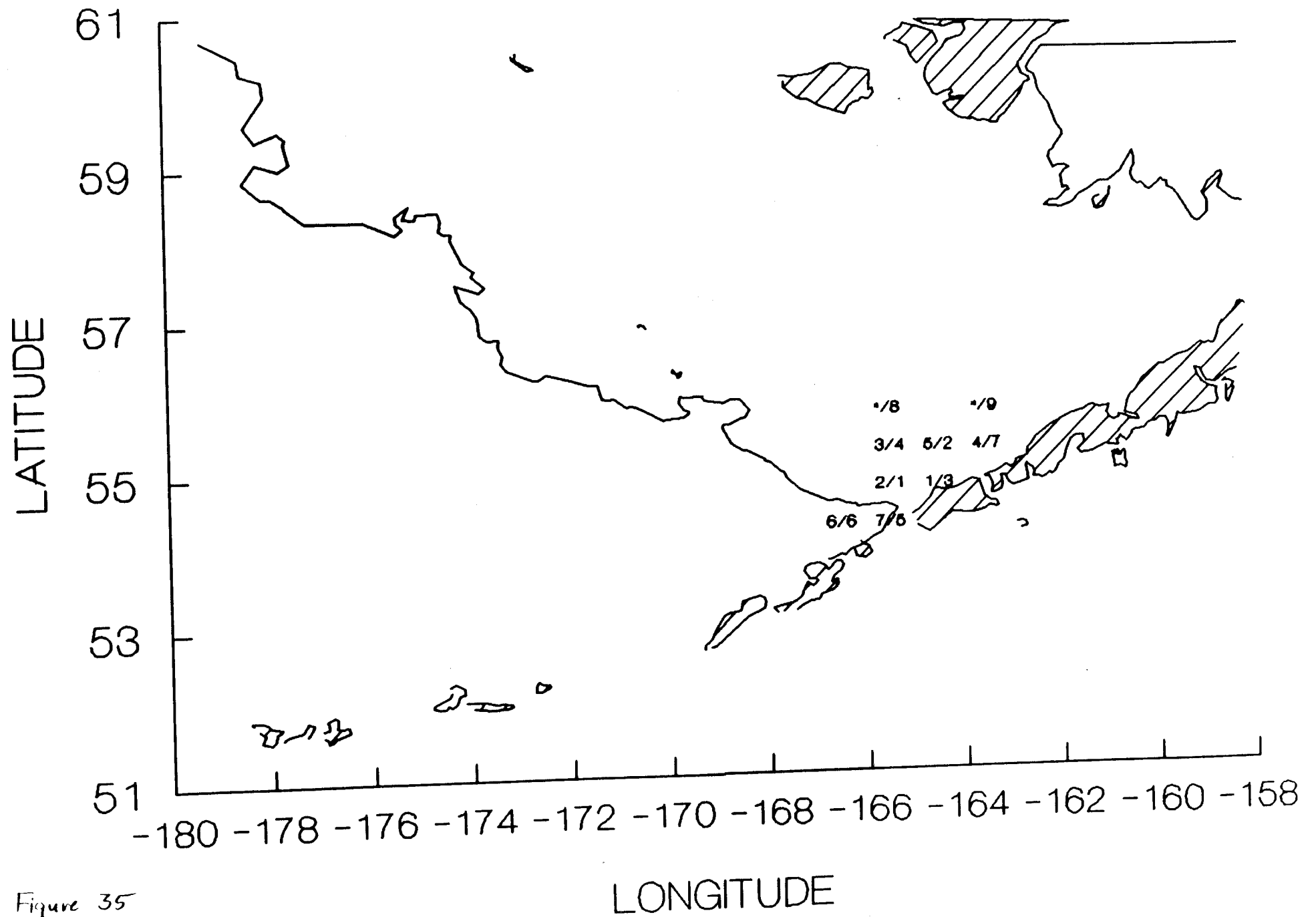


Figure 35

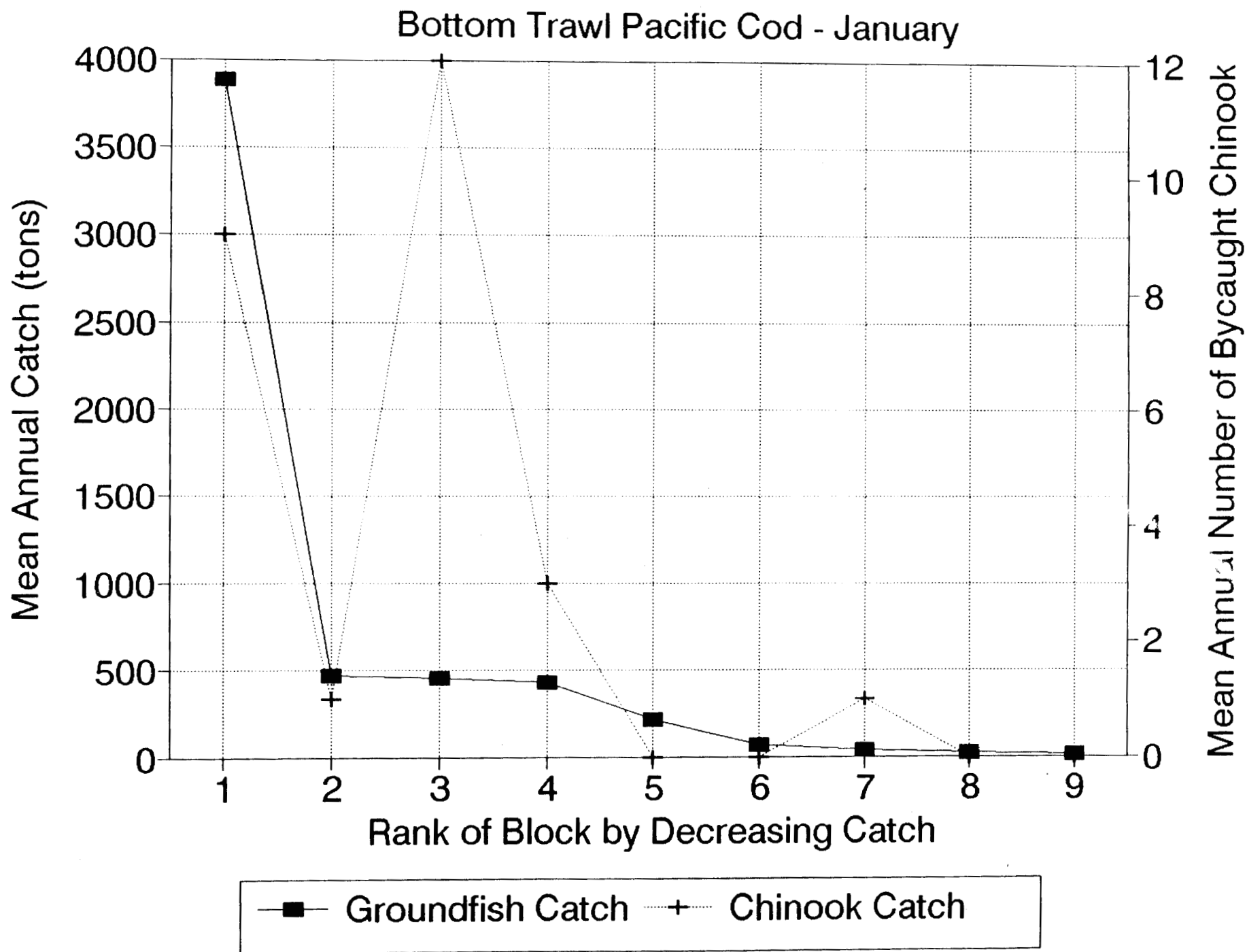


Figure 36 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the bottom trawl fishery for Pacific Cod during the month of January.

Bottom Trawl Pacific Cod - January

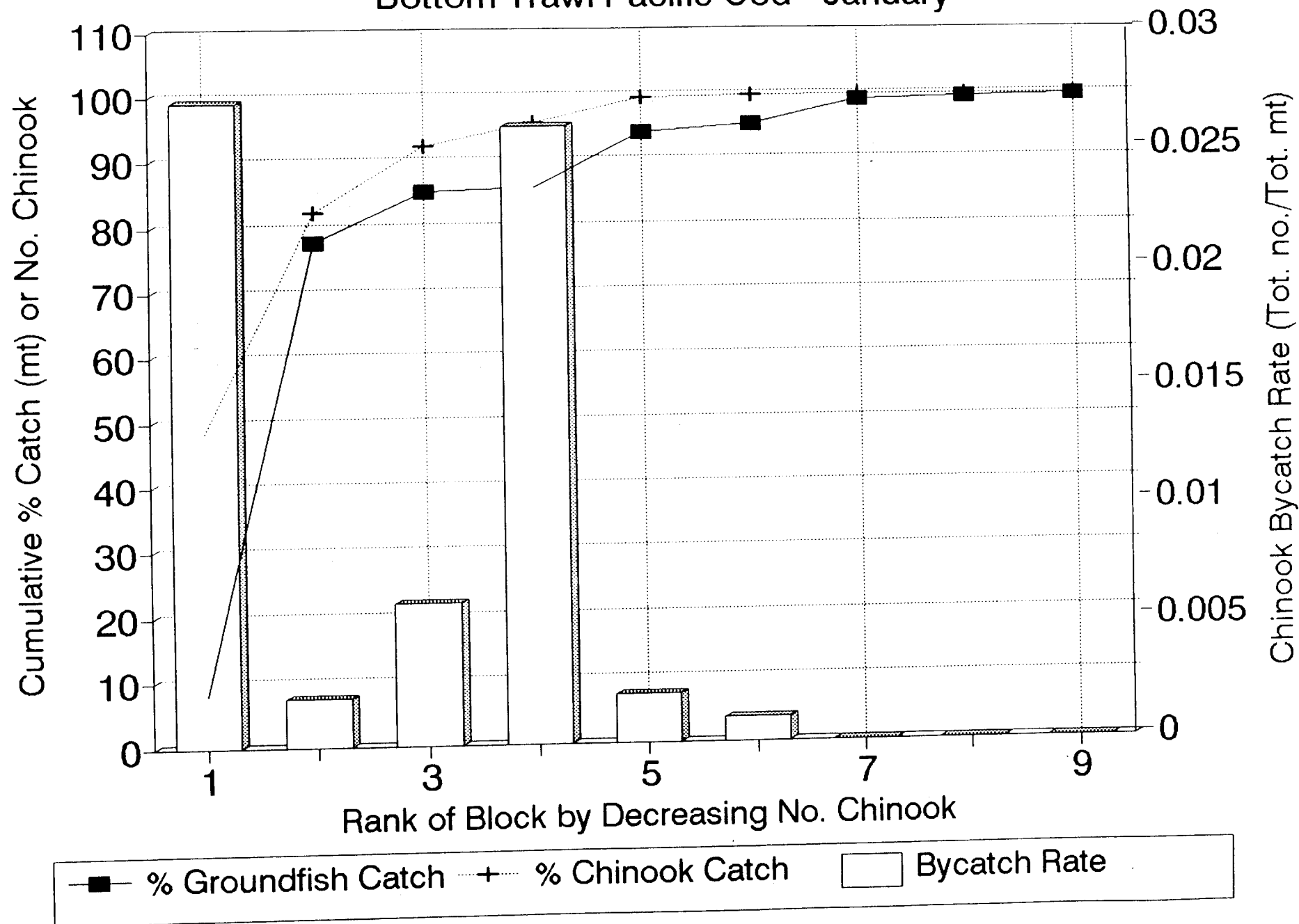


Figure 37 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the bottom trawl fishery for Pacific Cod during the month of January. Bycatch rates for each block are indicated by histograms.

April, 1980 - 1989. Mean King/Mean Catch. Bottom Trawl Cod

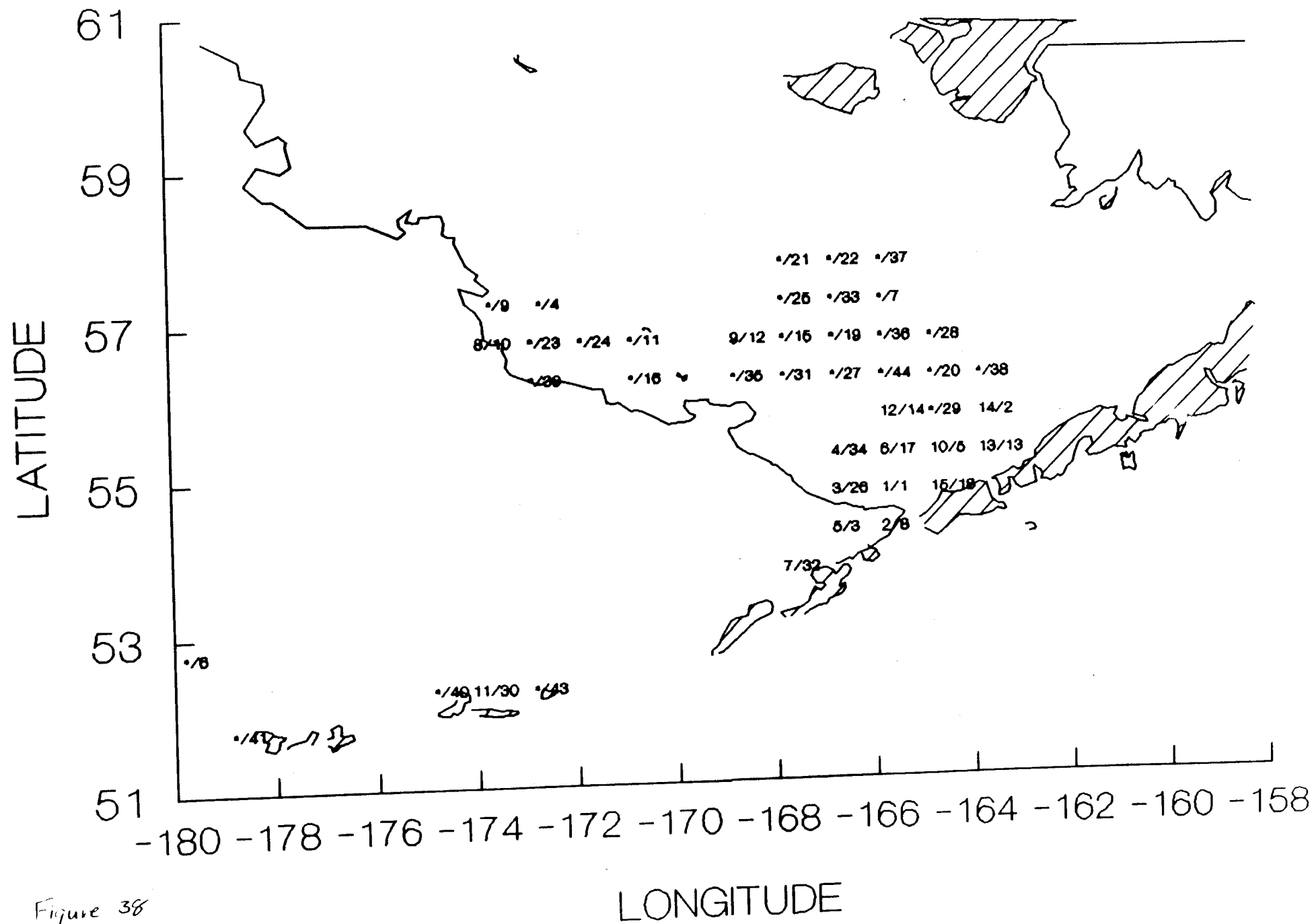


Figure 38

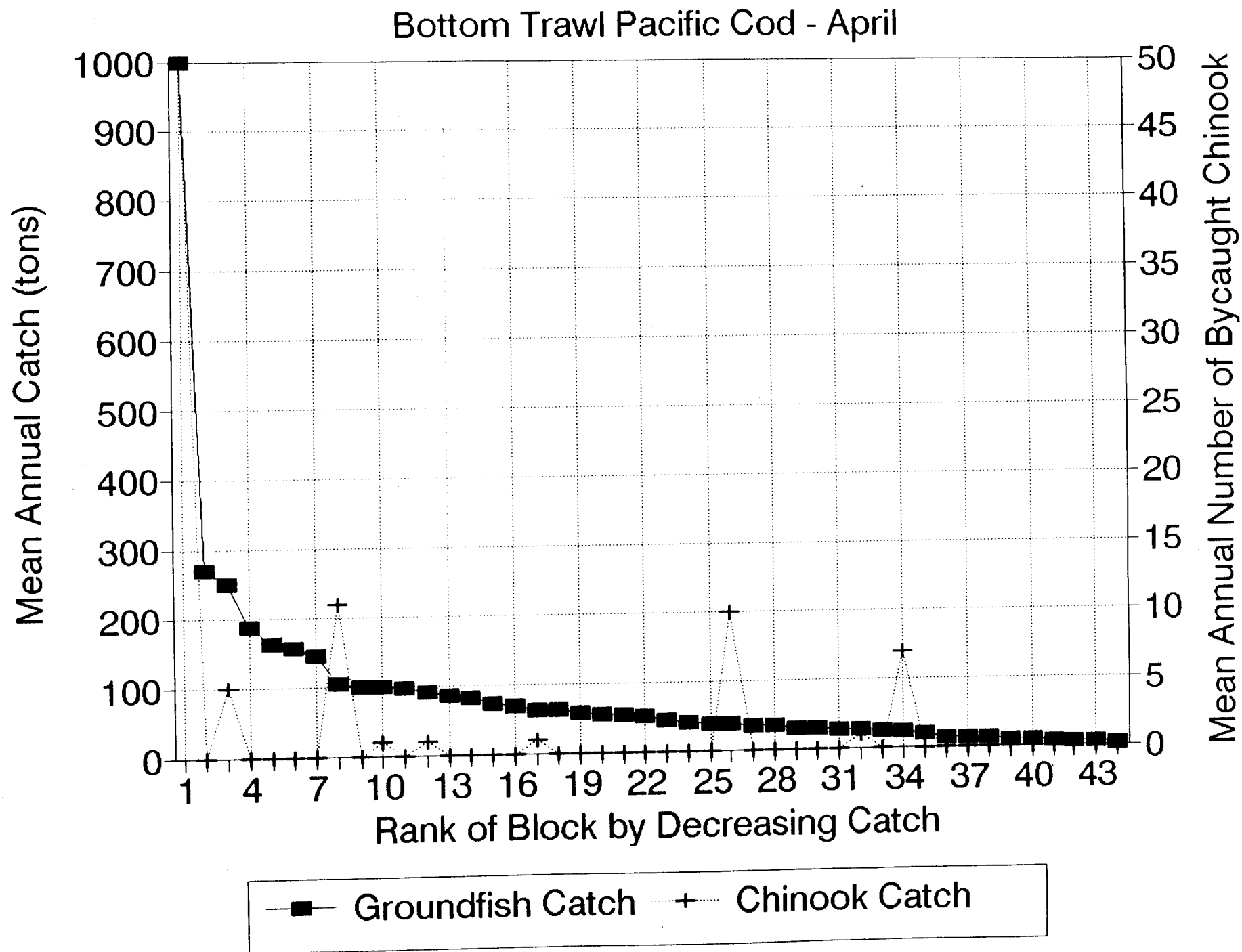


Figure 39 One degree latitude by 1/2 degree longitude block in order of decreasing catch. Mean annual catch and number of chinook salmon bycaught in the bottom trawl fishery for Pacific Cod during the month of April.

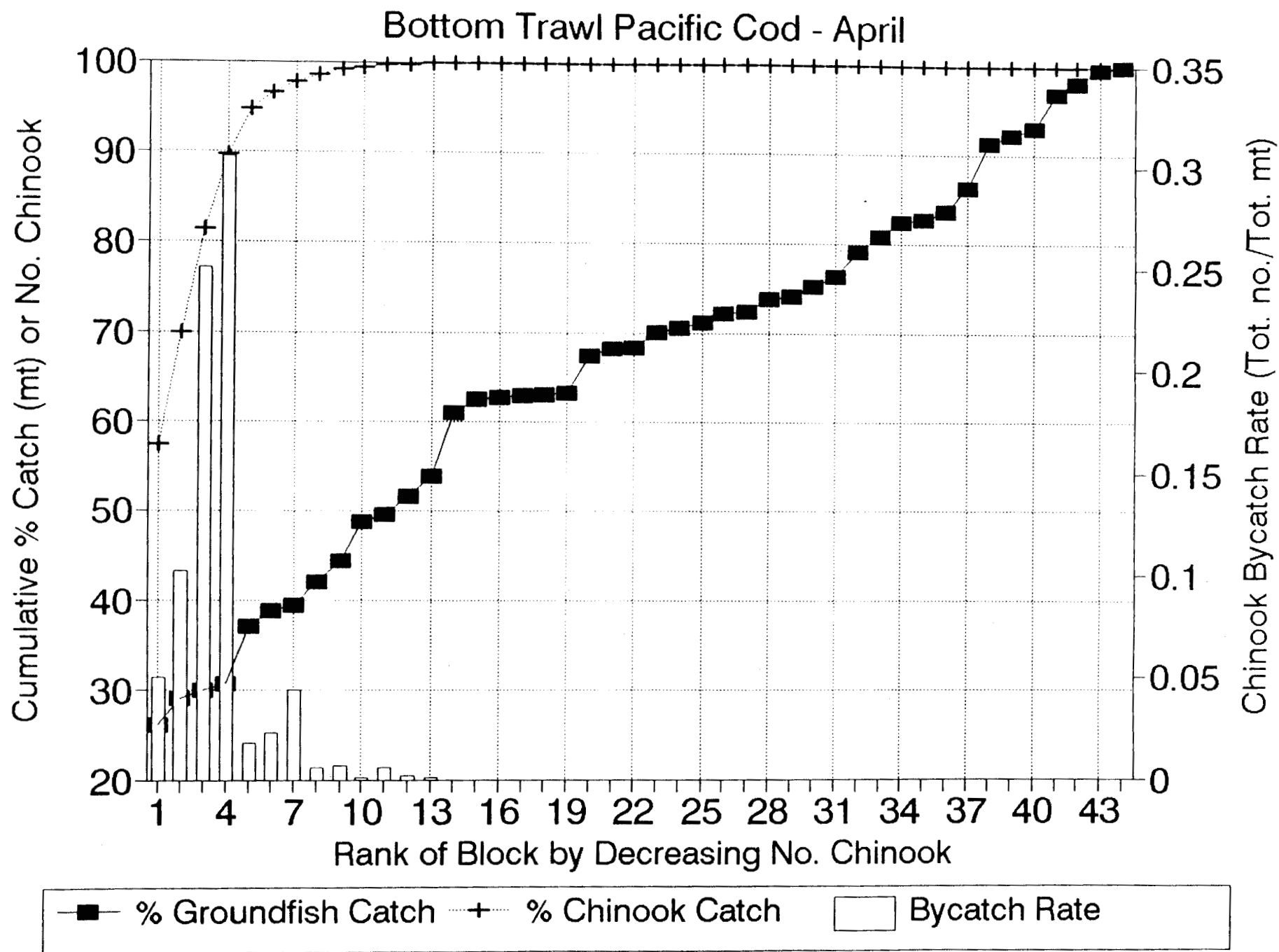
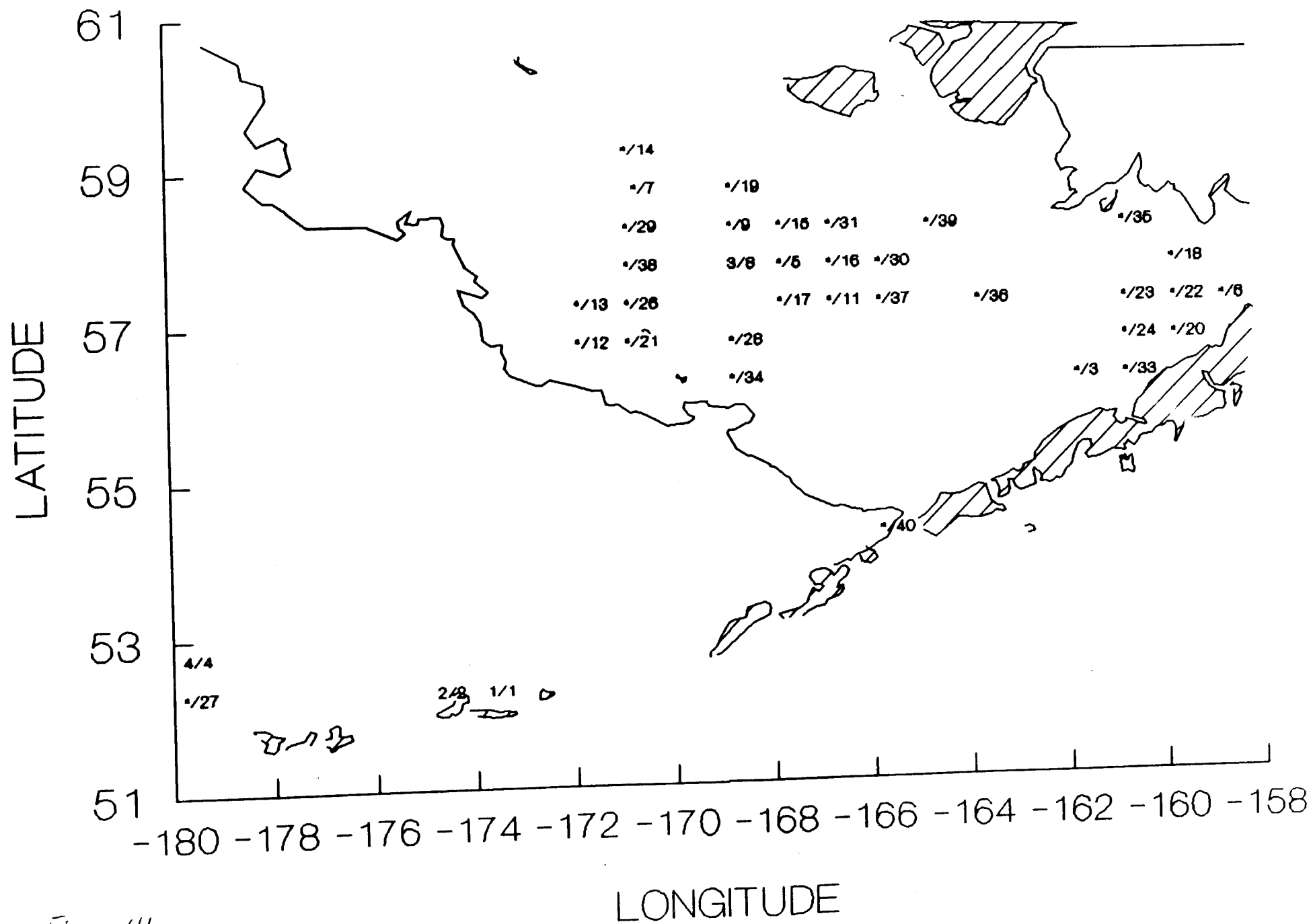


Figure 40 One degree latitude by 1/2 degree longitude block in order of decreasing number of chinook . Mean annual catch and number of bycaught chinook salmon (expressed as percentages) caught in the bottom trawl fishery for Pacific Cod during the month of April. Bycatch rates for each block are indicated by histograms.

June, 1980 - 1989. Mean King/Mean Catch. Bottom Trawl Cod



October, 1980 - 1989. Mean King/Mean Catch Ratio. Bottom Trawl Cod

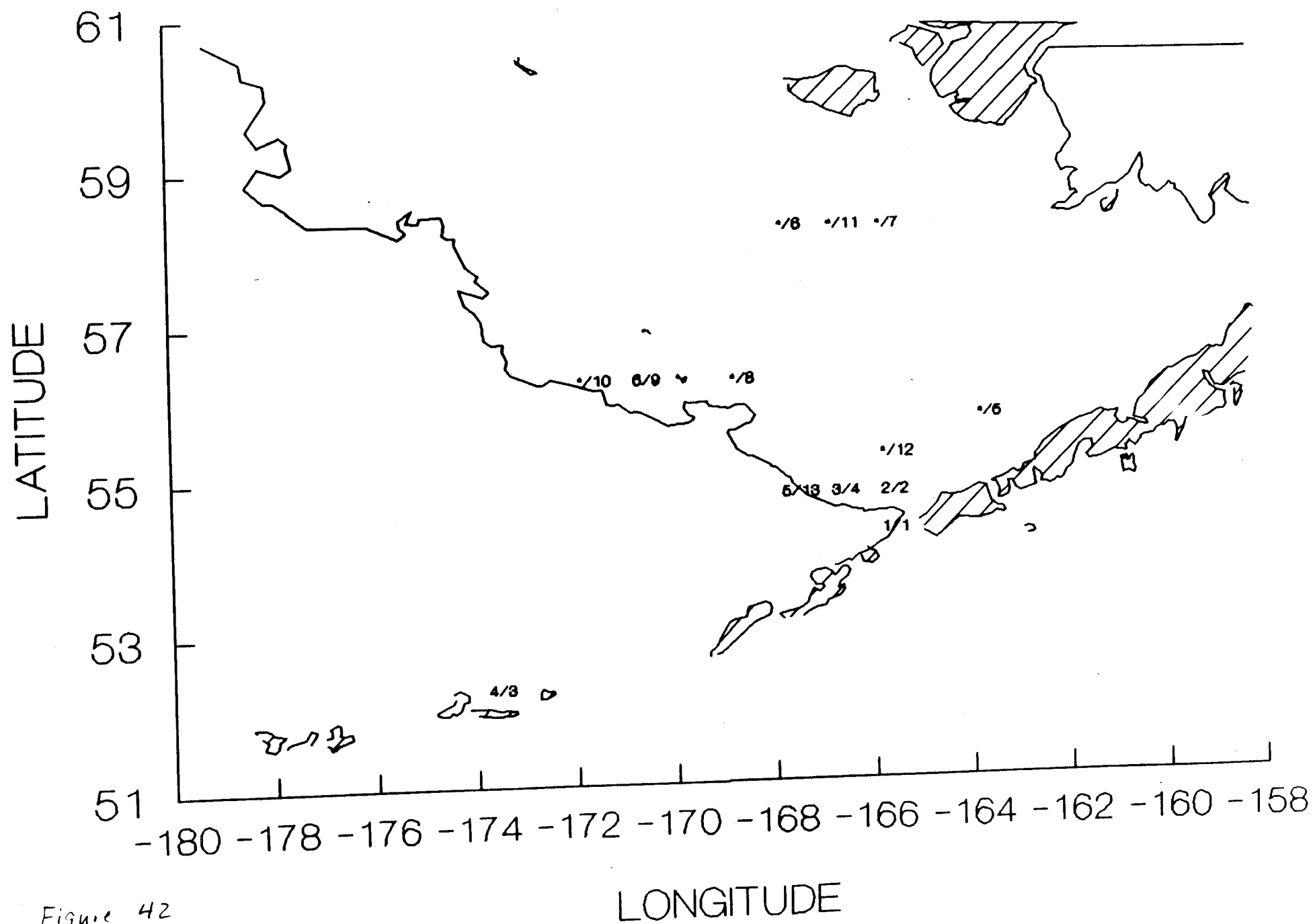
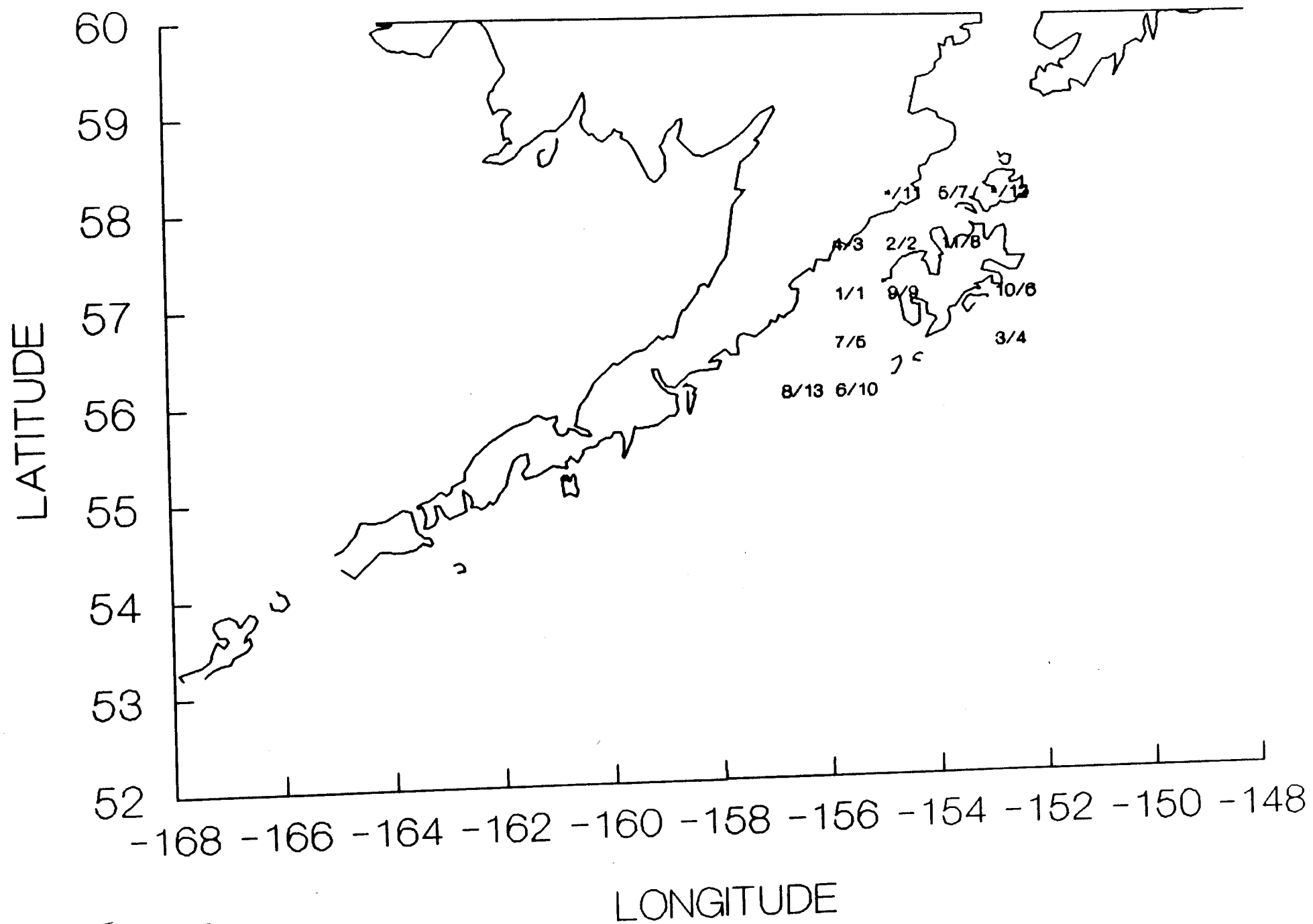
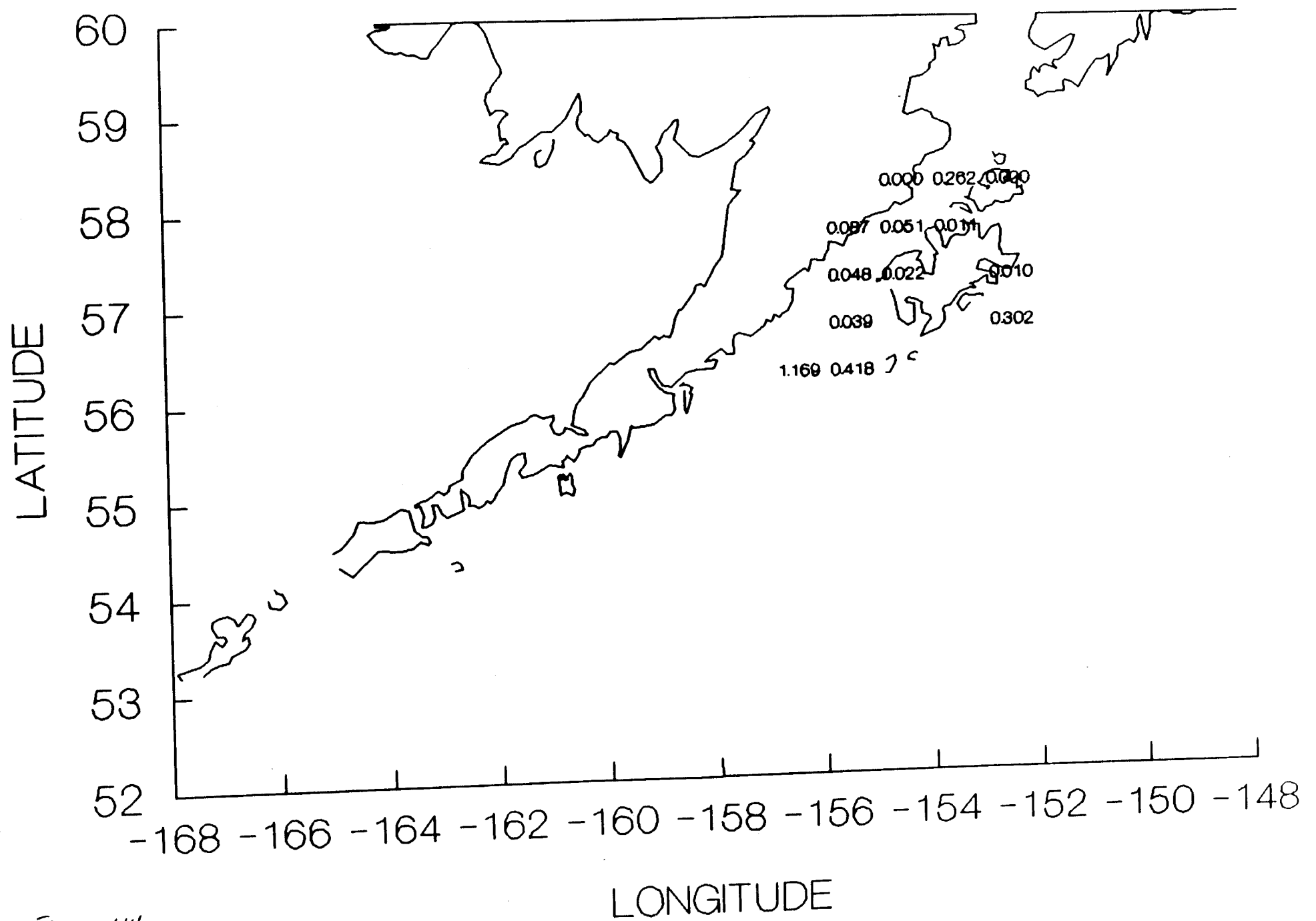


Figure 42

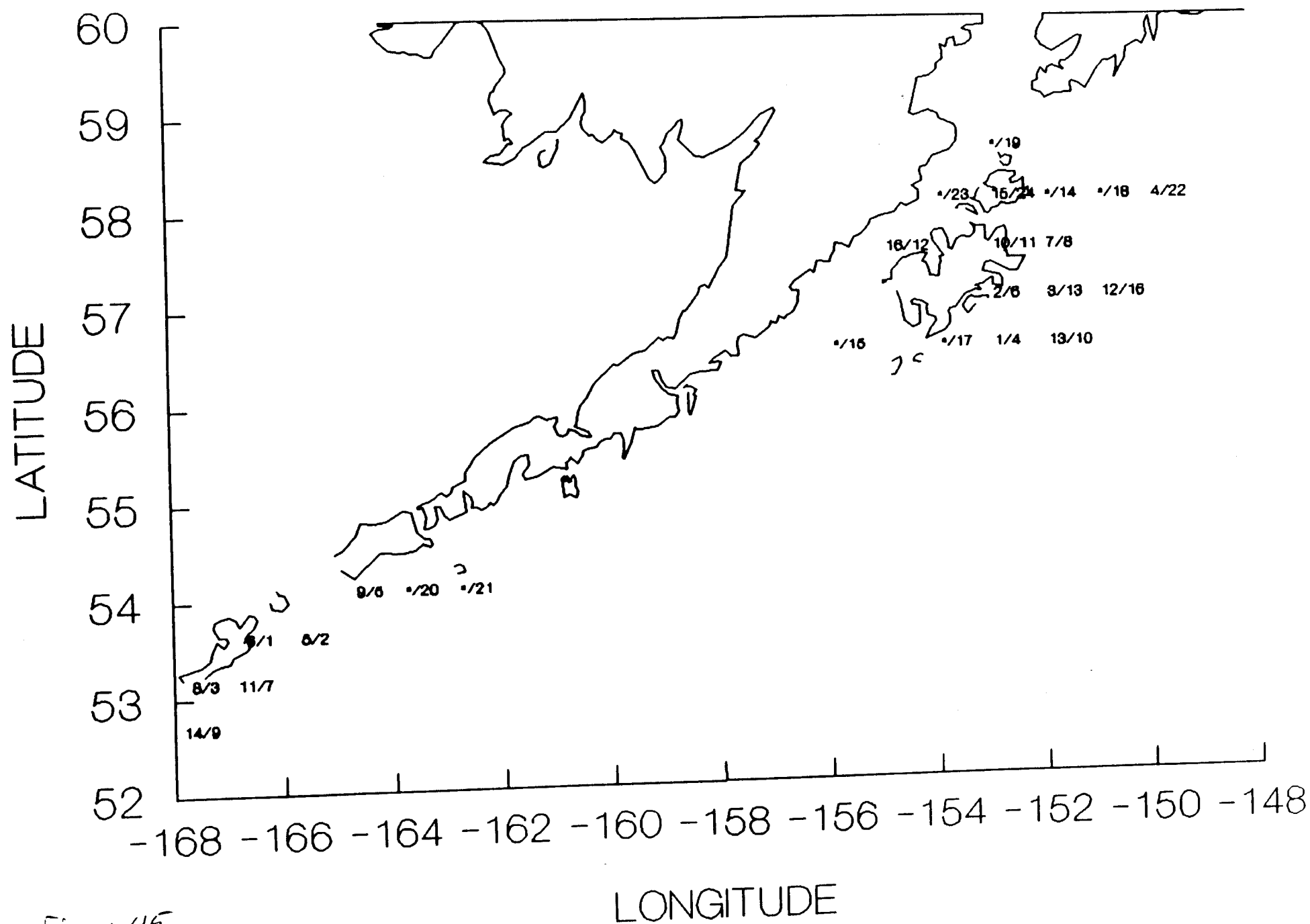
GOA. February, 1980 - 1989. Mean King/Mean Catch. Bottom Trawl Pollock



GOA. February, 1980 - 1989. Bycatch Rate. Bottom Trawl Pollock



GOA. October. 1980 - 1989. Mean King/Mean Catch, Bottom Trawl Pollock



GOA. October, 1980 - 1989. Bycatch Rate. Bottom Trawl Pollock

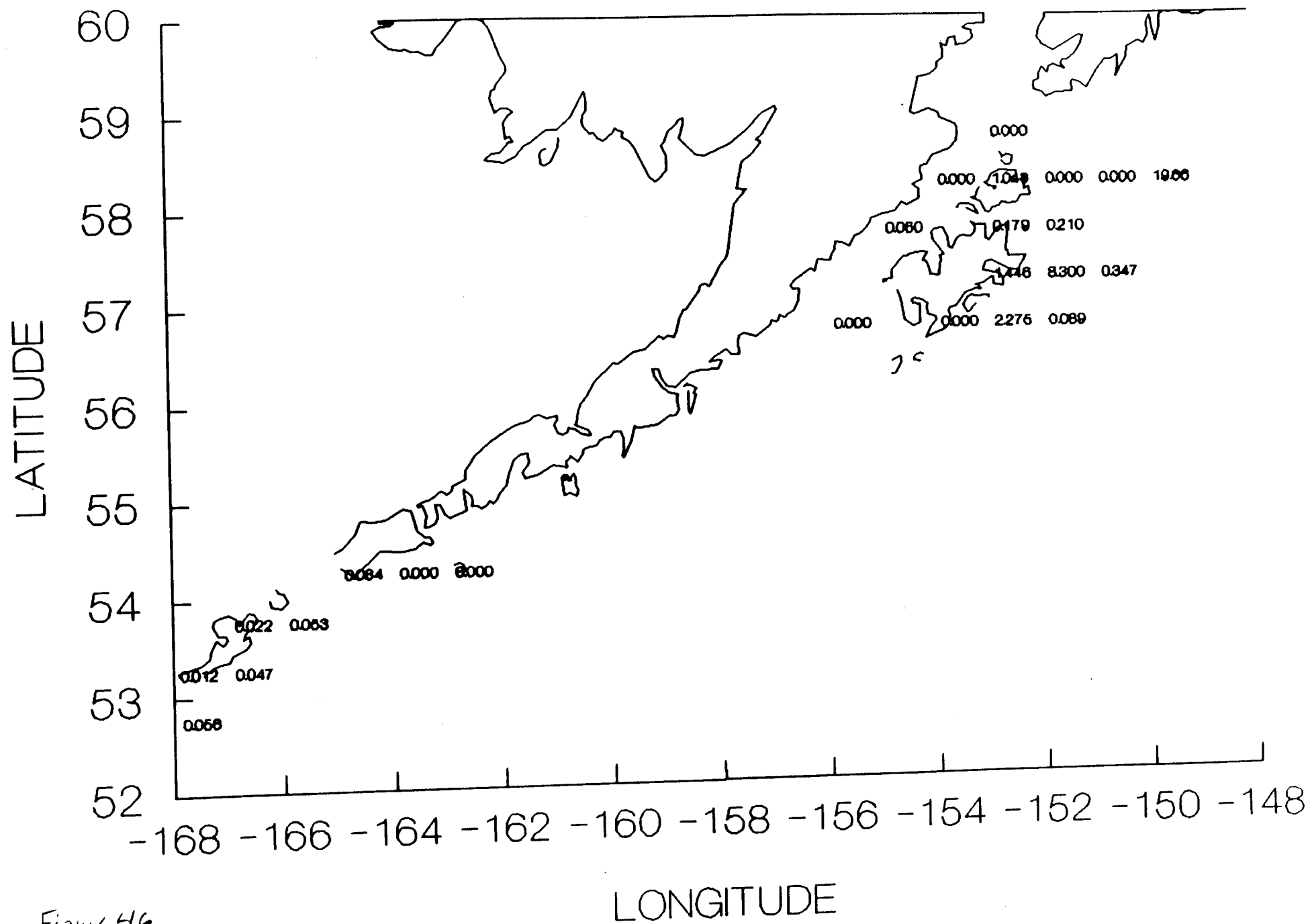


Figure 46

GOA. November. 1980 - 1989. Mean King/Mean Catch, Bottom Trawl Pollock

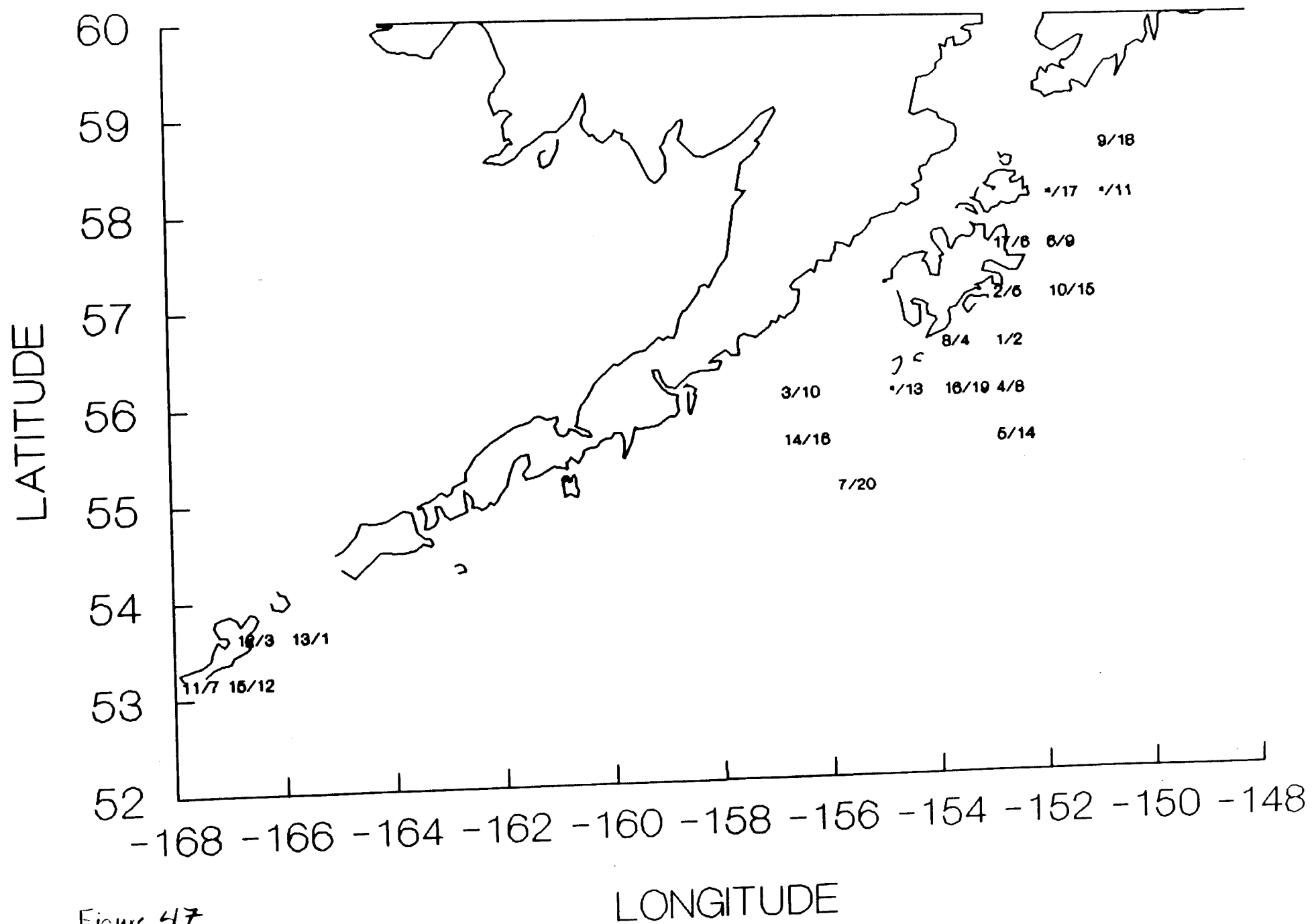
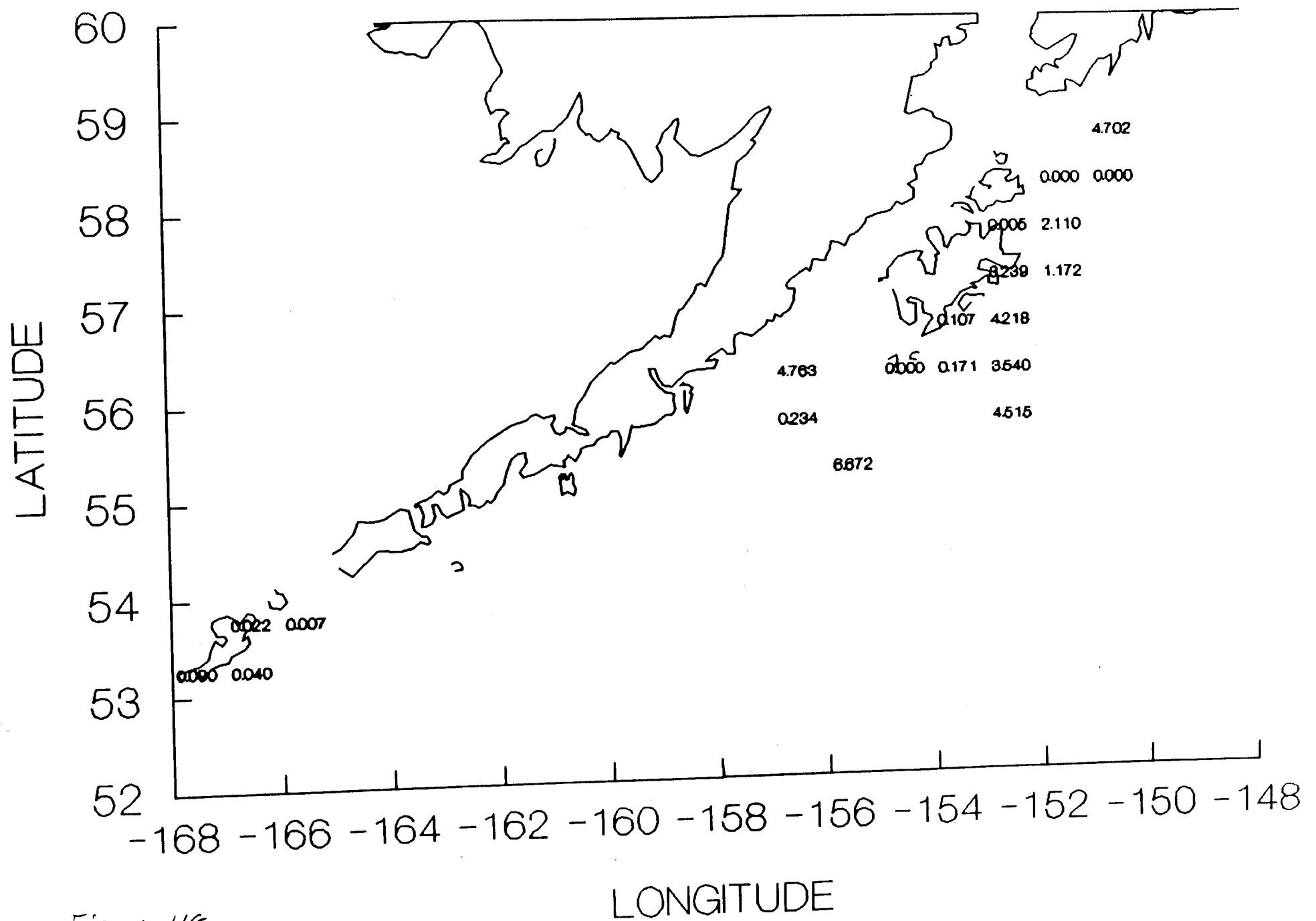
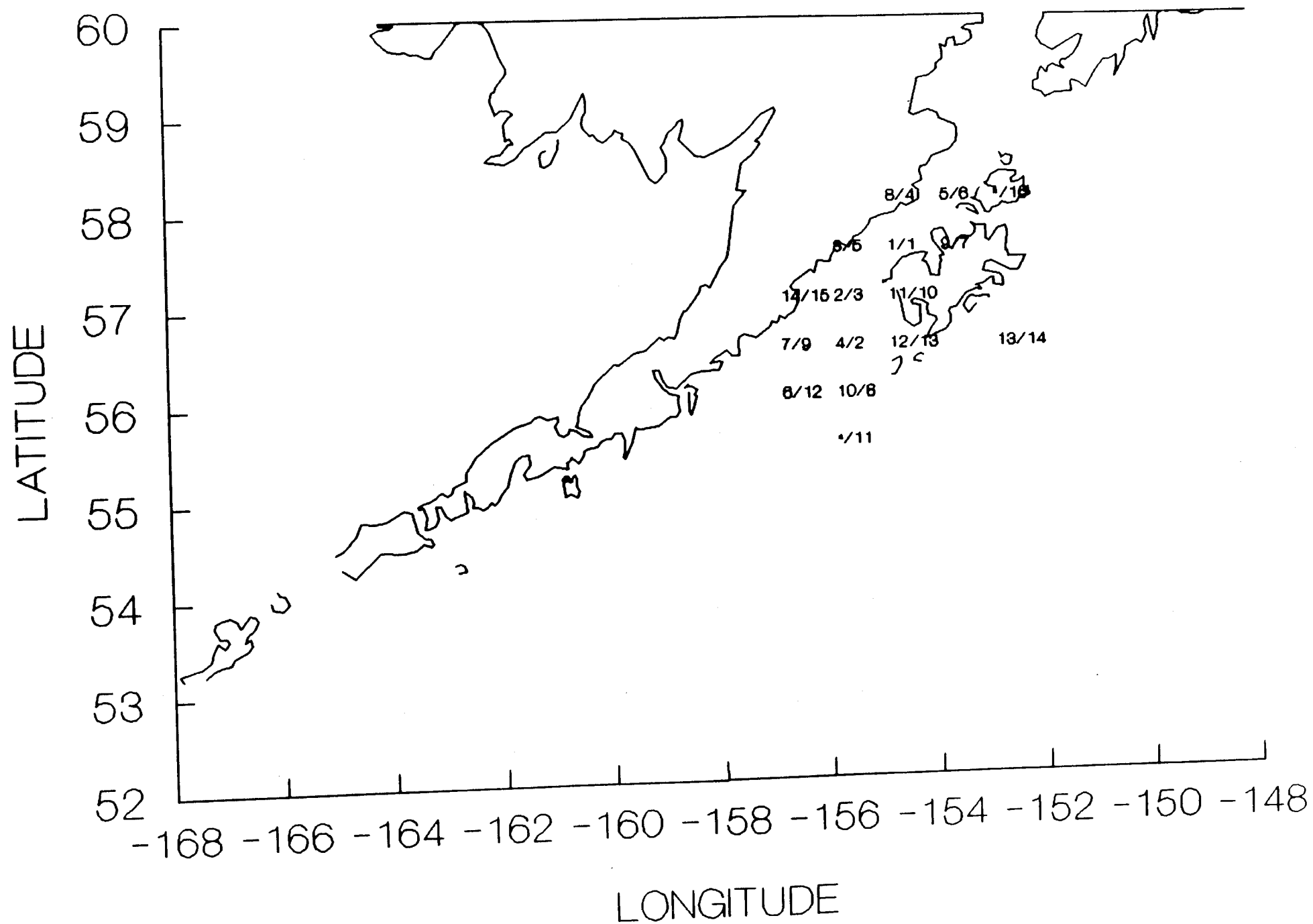


Figure 47

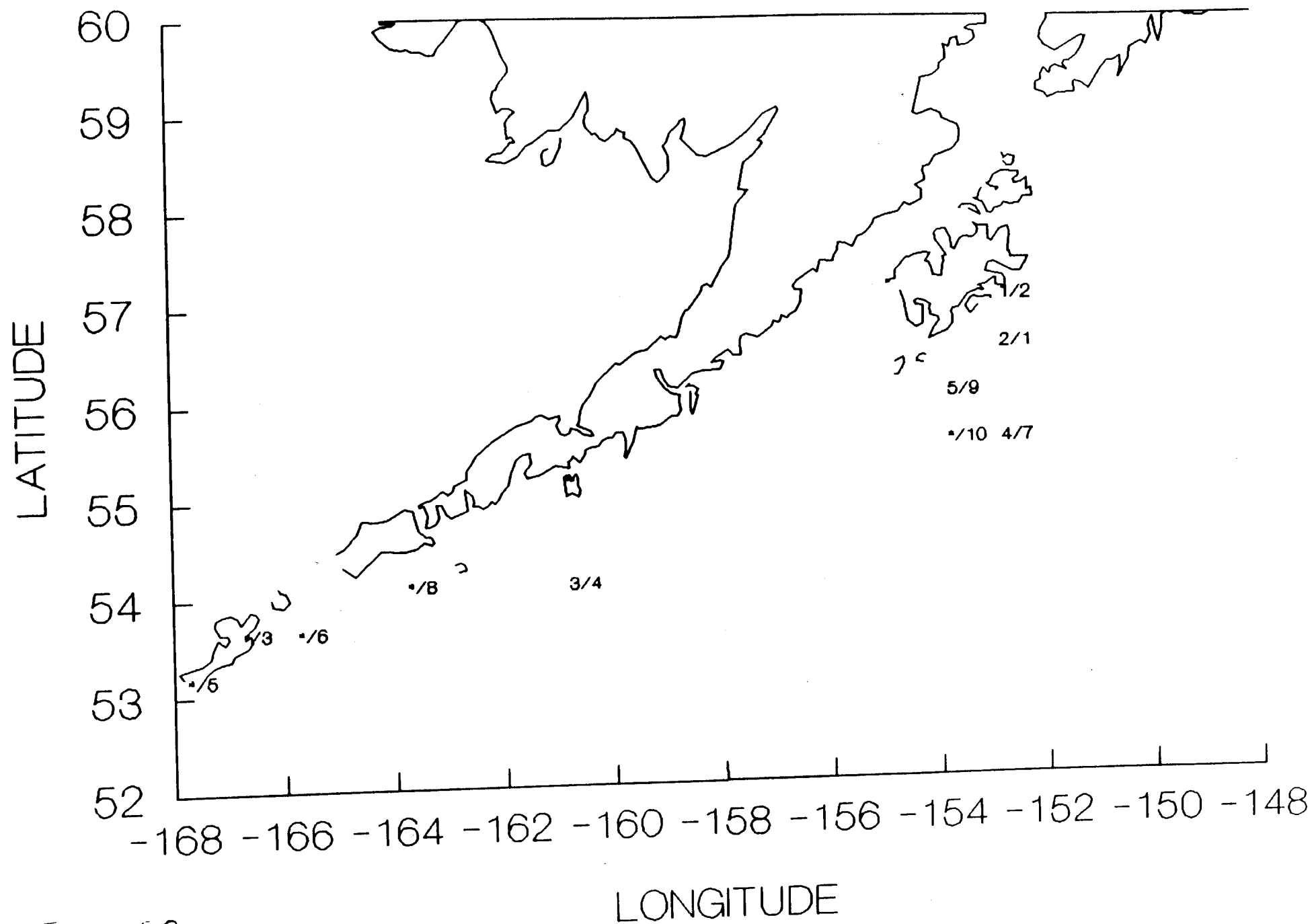
GOA. November, 1980 - 1989. Bycatch Rate. Bottom Trawl Pollock



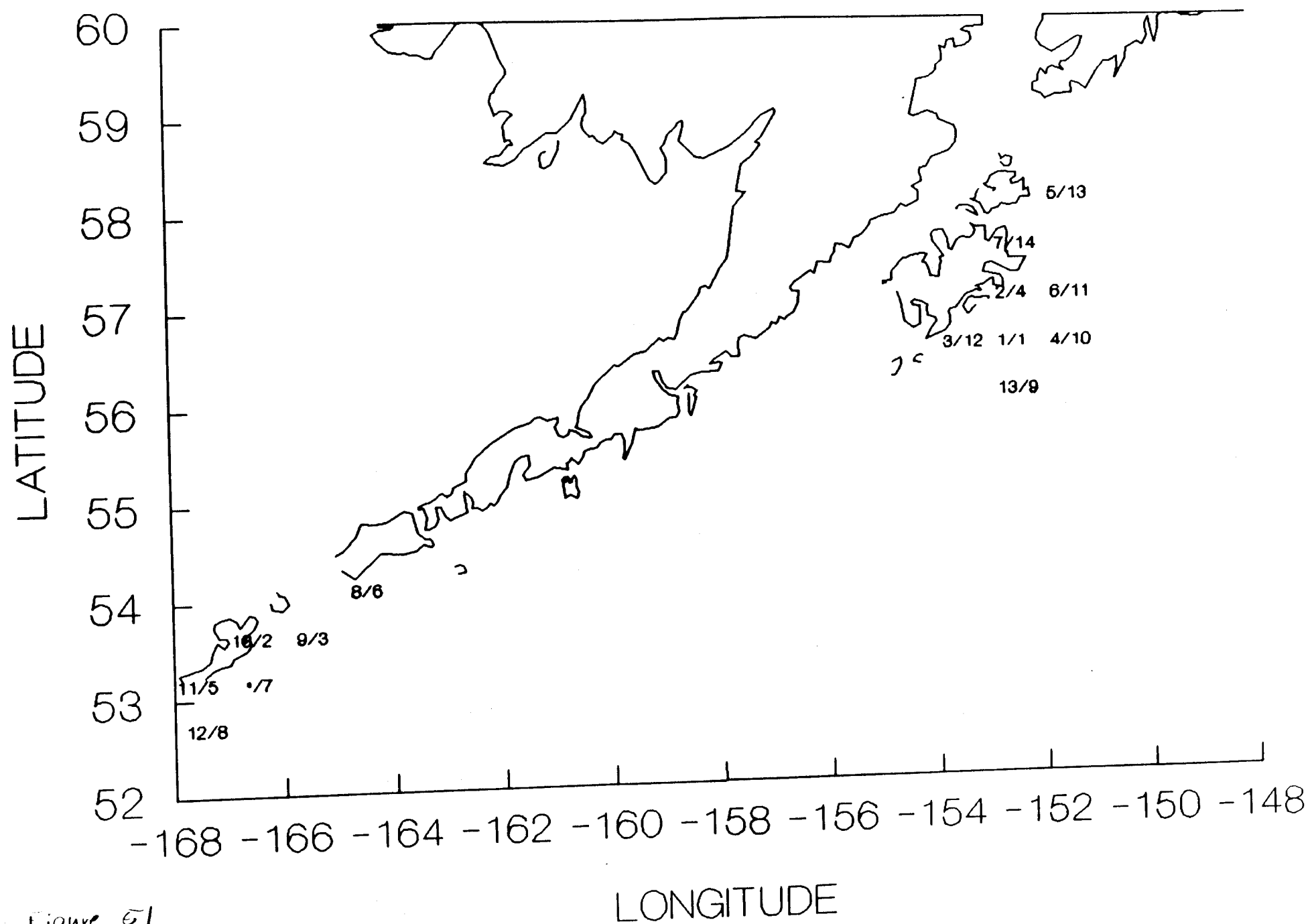
GOA. February, 1980 - 1989. Mean King/Mean Catch. Pelagic Trawl Pollock



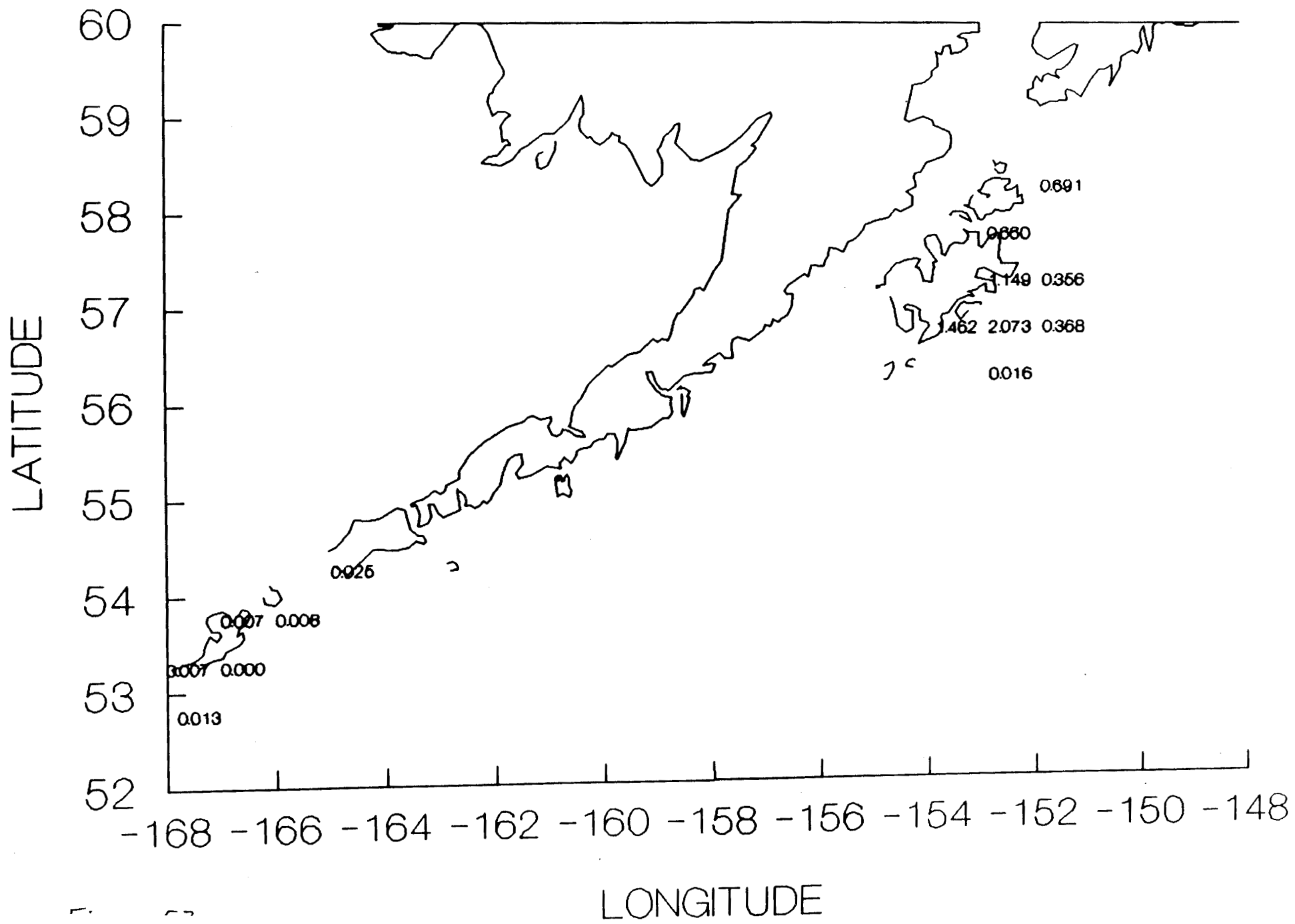
GOA. September, 1980 - 1989. Mean King/Mean Catch. Pelagic Trawl Pollock



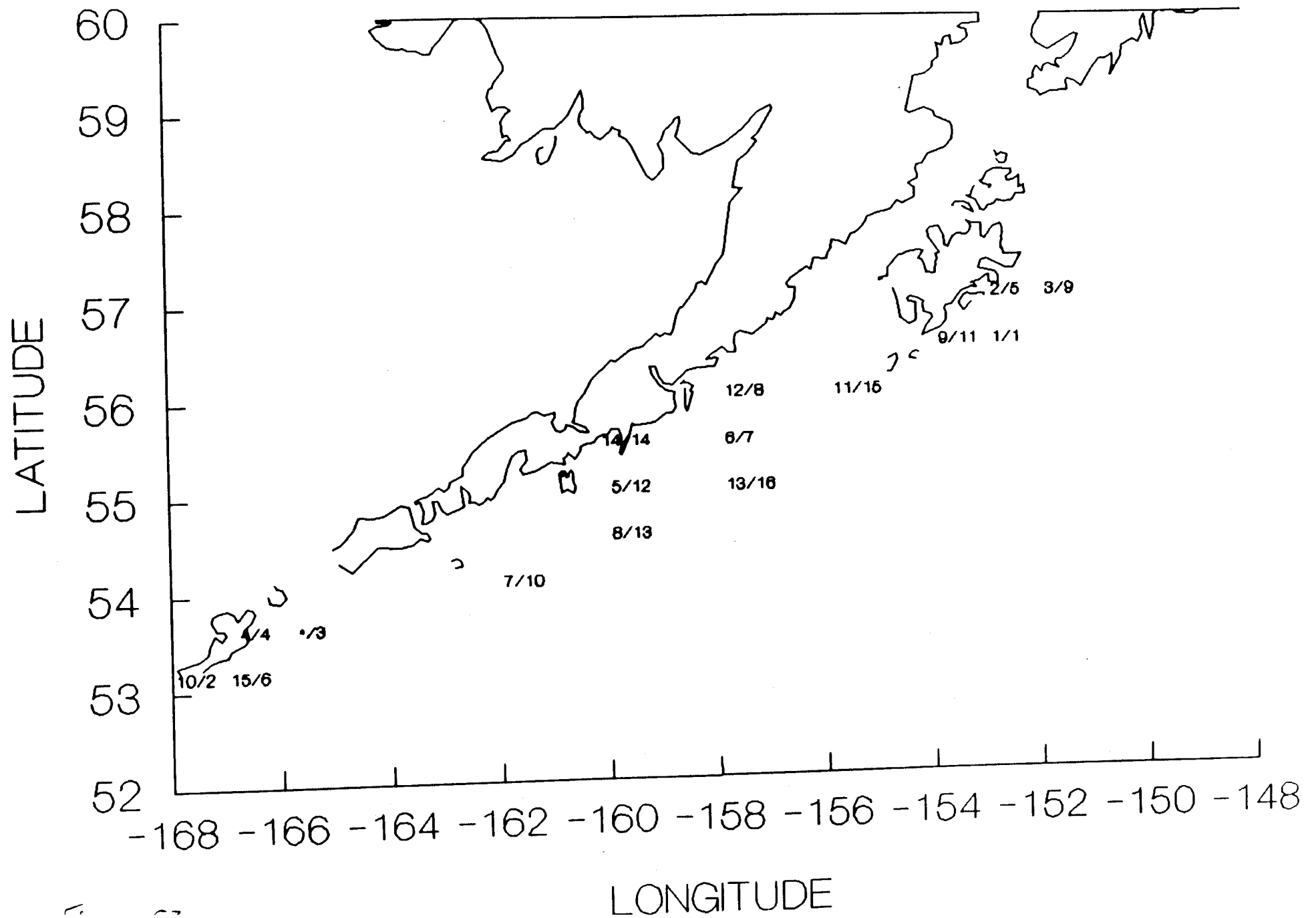
GOA. October, 1980 - 1989. Mean King/Mean Catch. Pelagic Trawl Pollock



GOA, October, 1980 - 1989. Bycatch Rate. Pelagic Trawl Pollock



GOA. November. 1980 - 1989. Mean King/Mean Catch. Pelagic Trawl Pollock



GOA. November. 1980 - 1989. Bycatch Rate. Pelagic Trawl Pollock

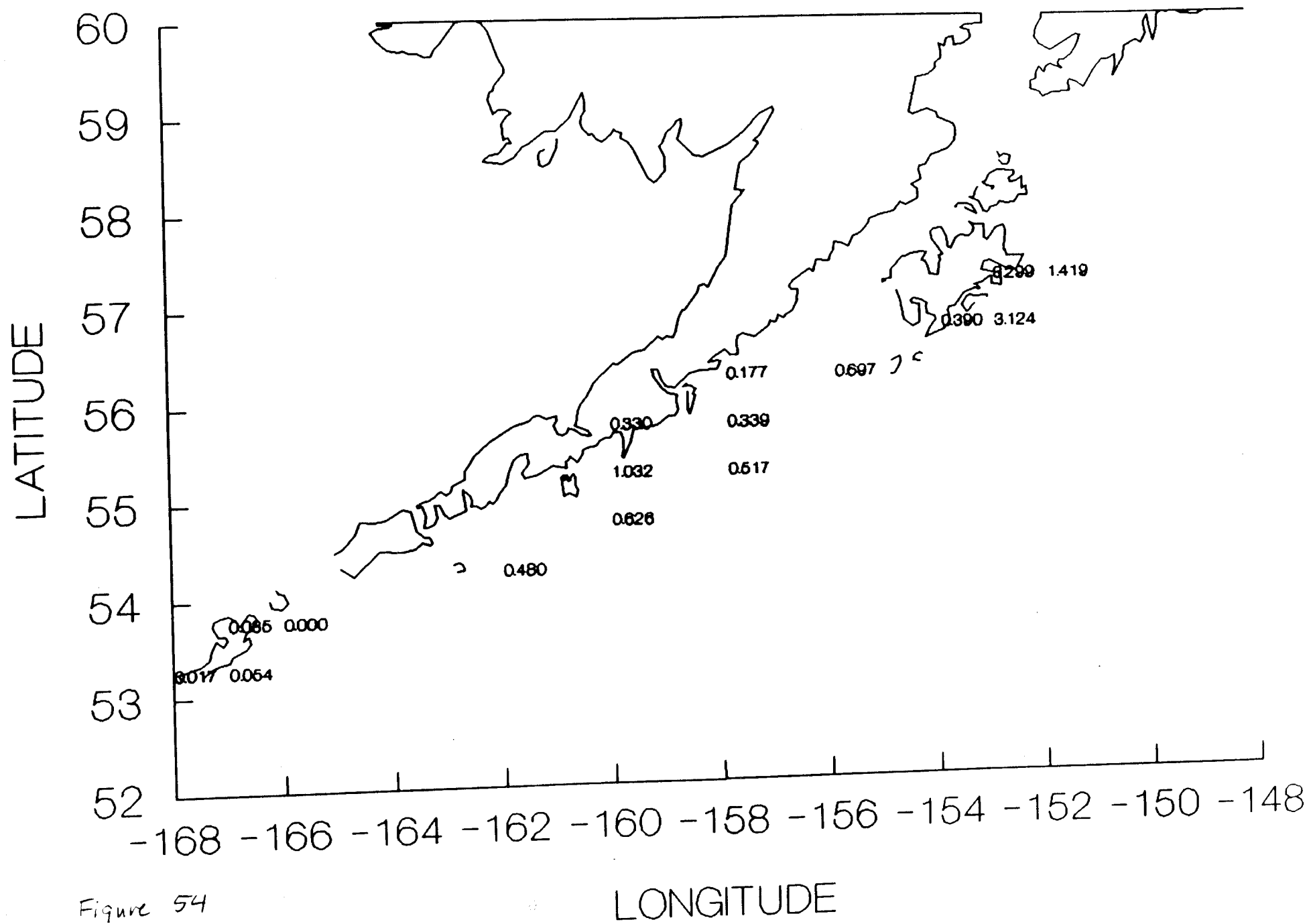


Figure 54

January, 1990. King Rank/Catch Rank. Domestic Bottom Trawl Pollock
Revised

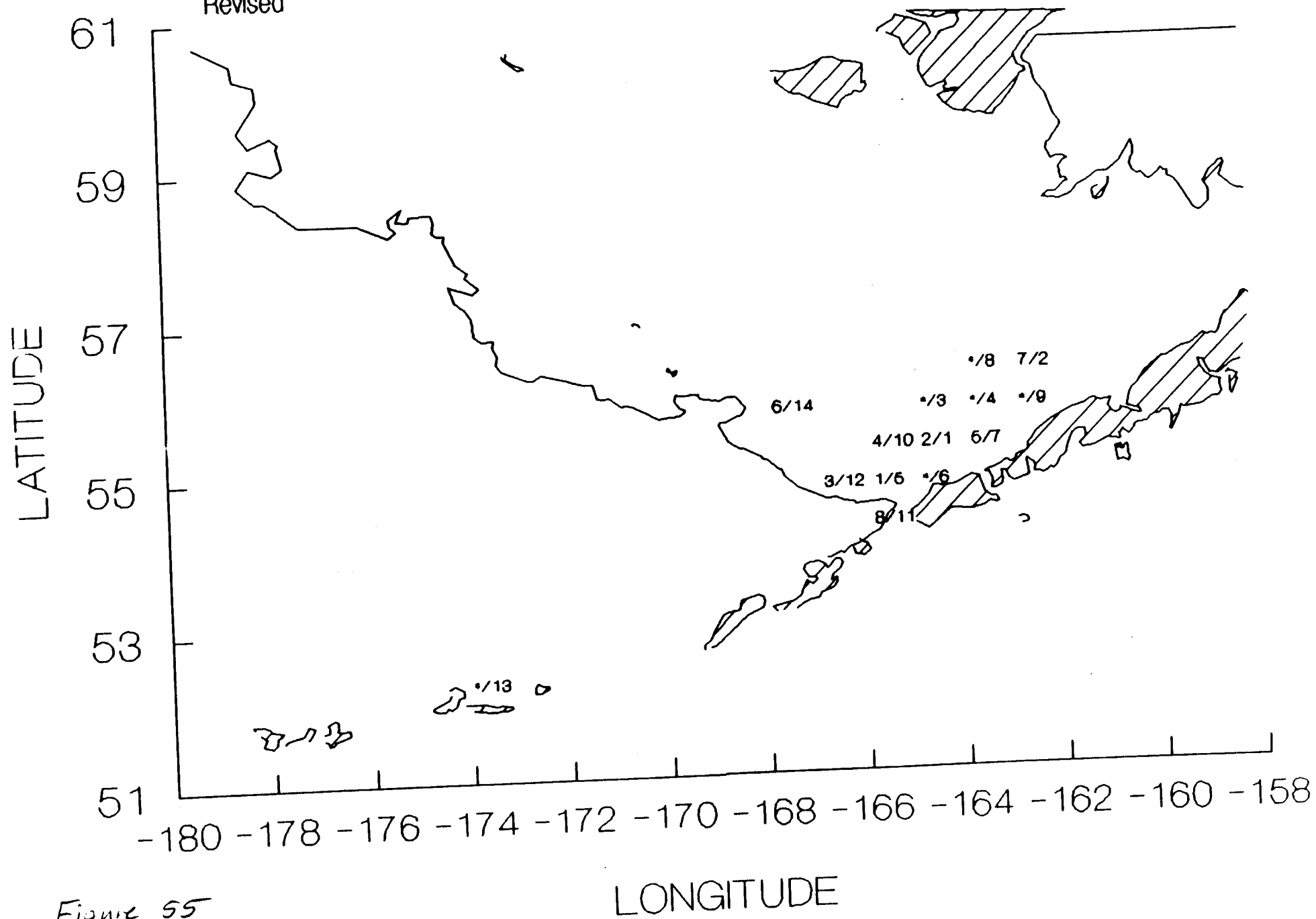


Figure 55

April, 1990. King Rank/Catch Rank. Domestic Bottom Trawl Pollock
Revised

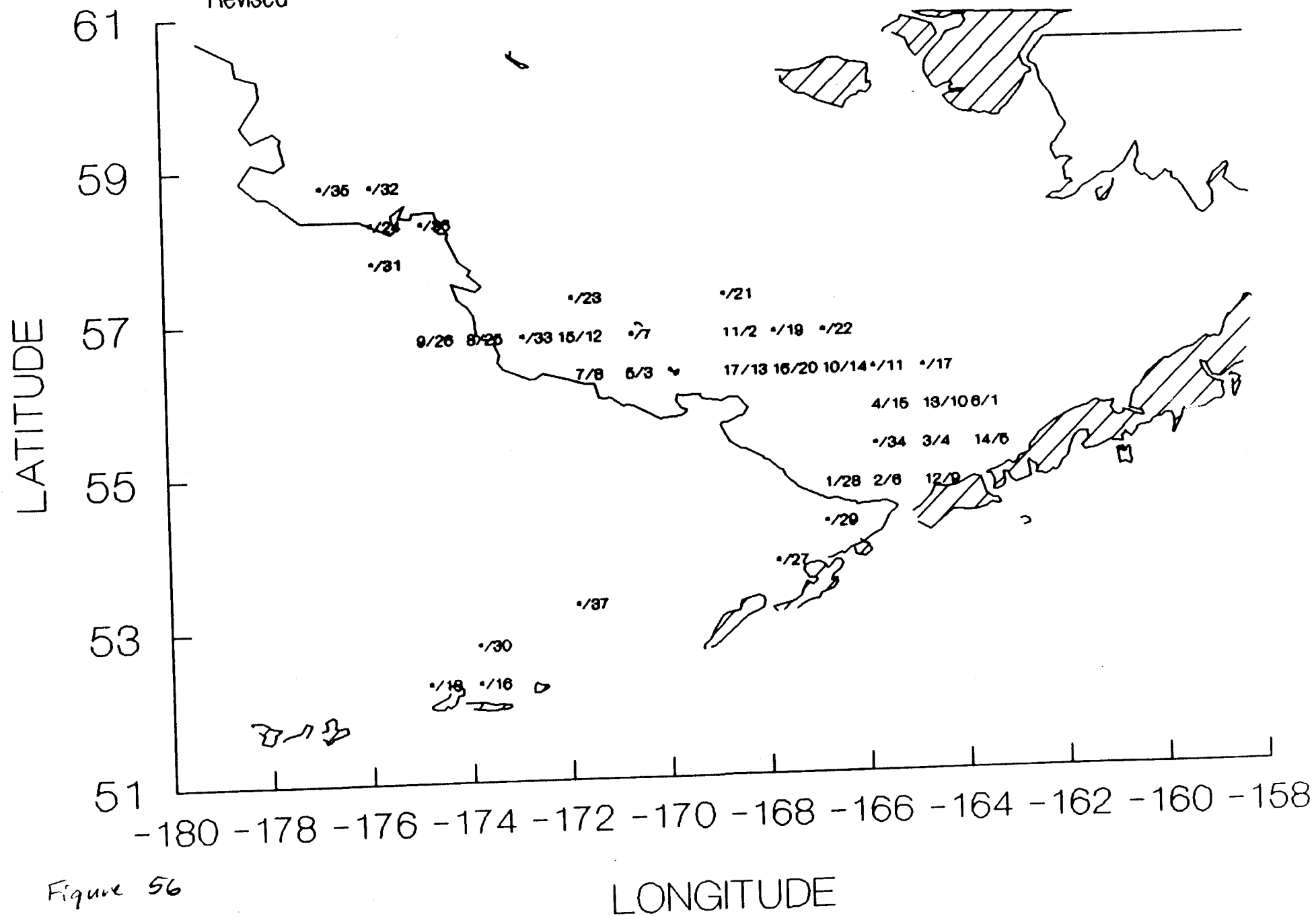
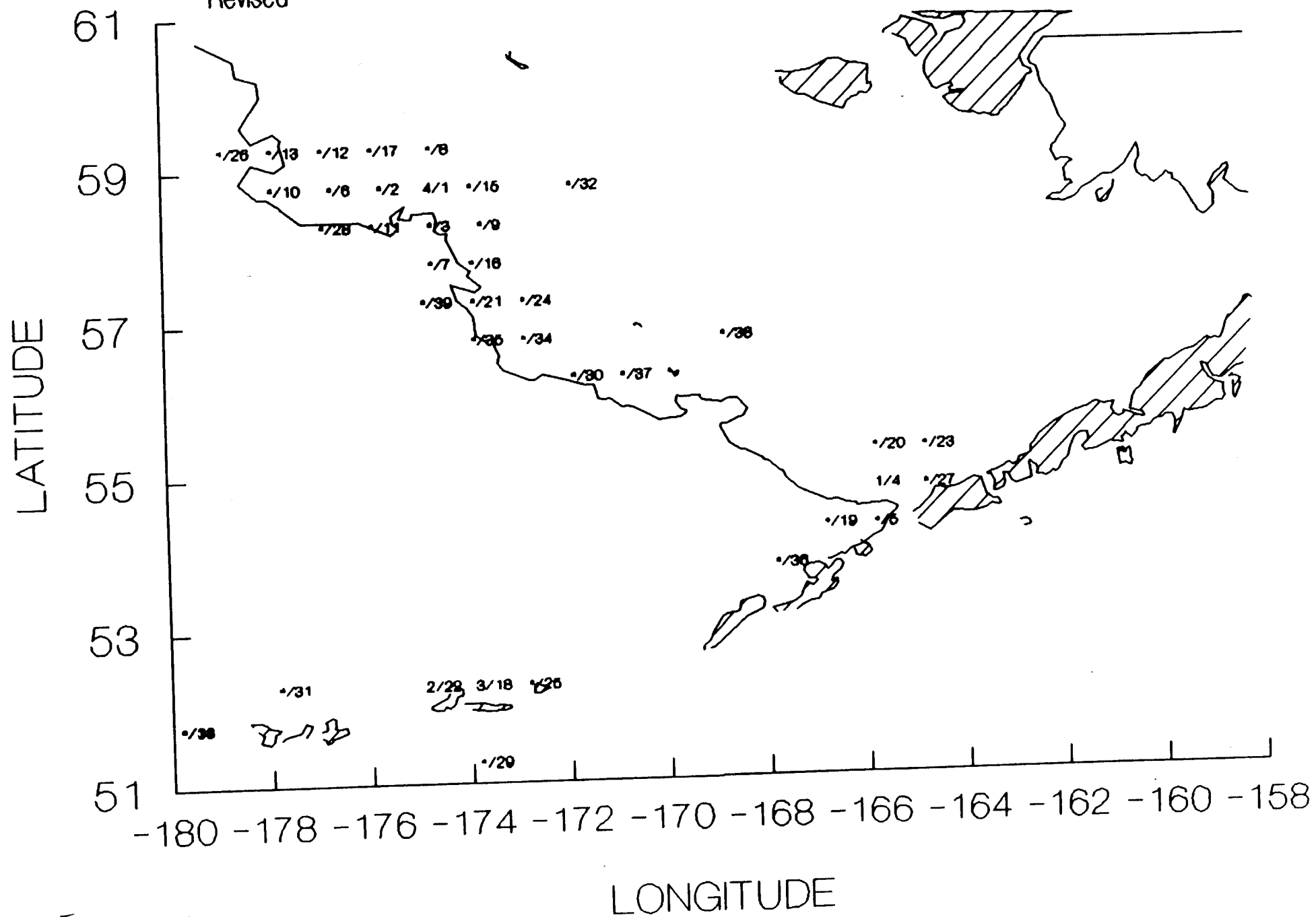


Figure 56

June, 1990. King Rank/Catch Rank. Domestic Bottom Trawl Pollock
Revised



August. 1990. King Rank/Catch Rank. Domestic Bottom Trawl Pollock
Revised

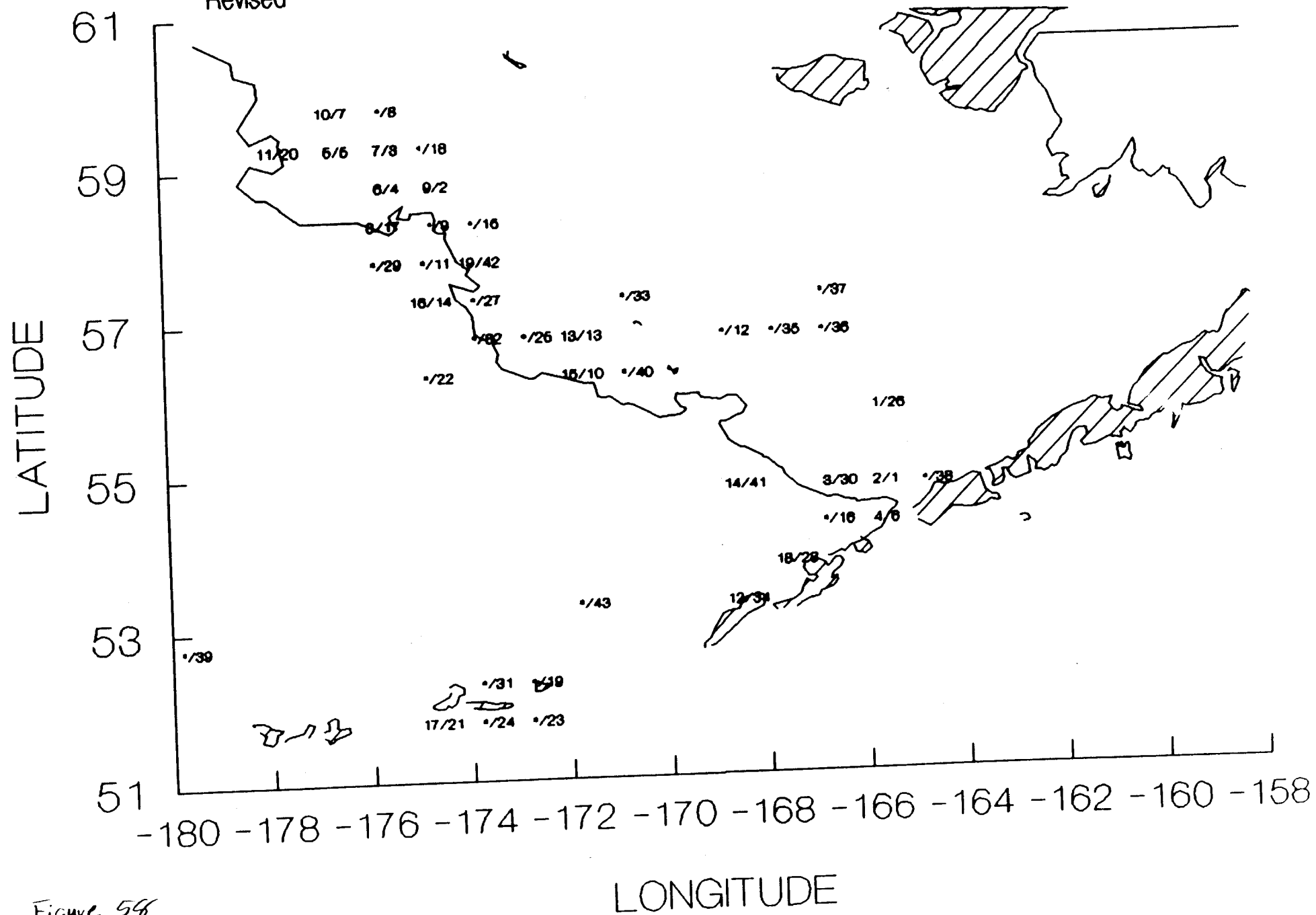


Figure 58

November, 1990. King Rank/Catch Rank. Domestic Bottom Trawl Pollock
Revised

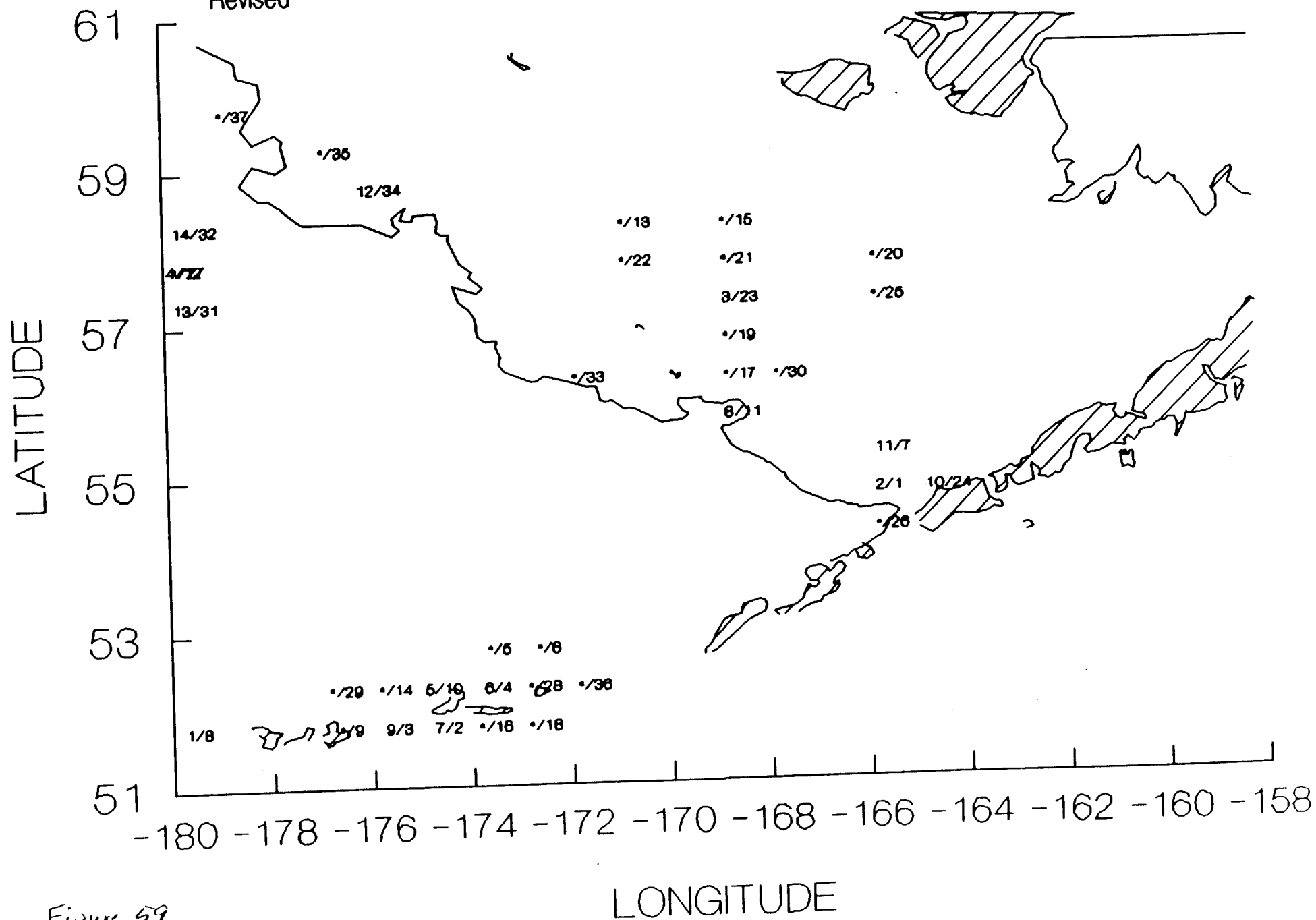


Figure 59

January, 1990. King Rank/Catch Rank. Domestic Pelagic Trawl Pollock
Revised

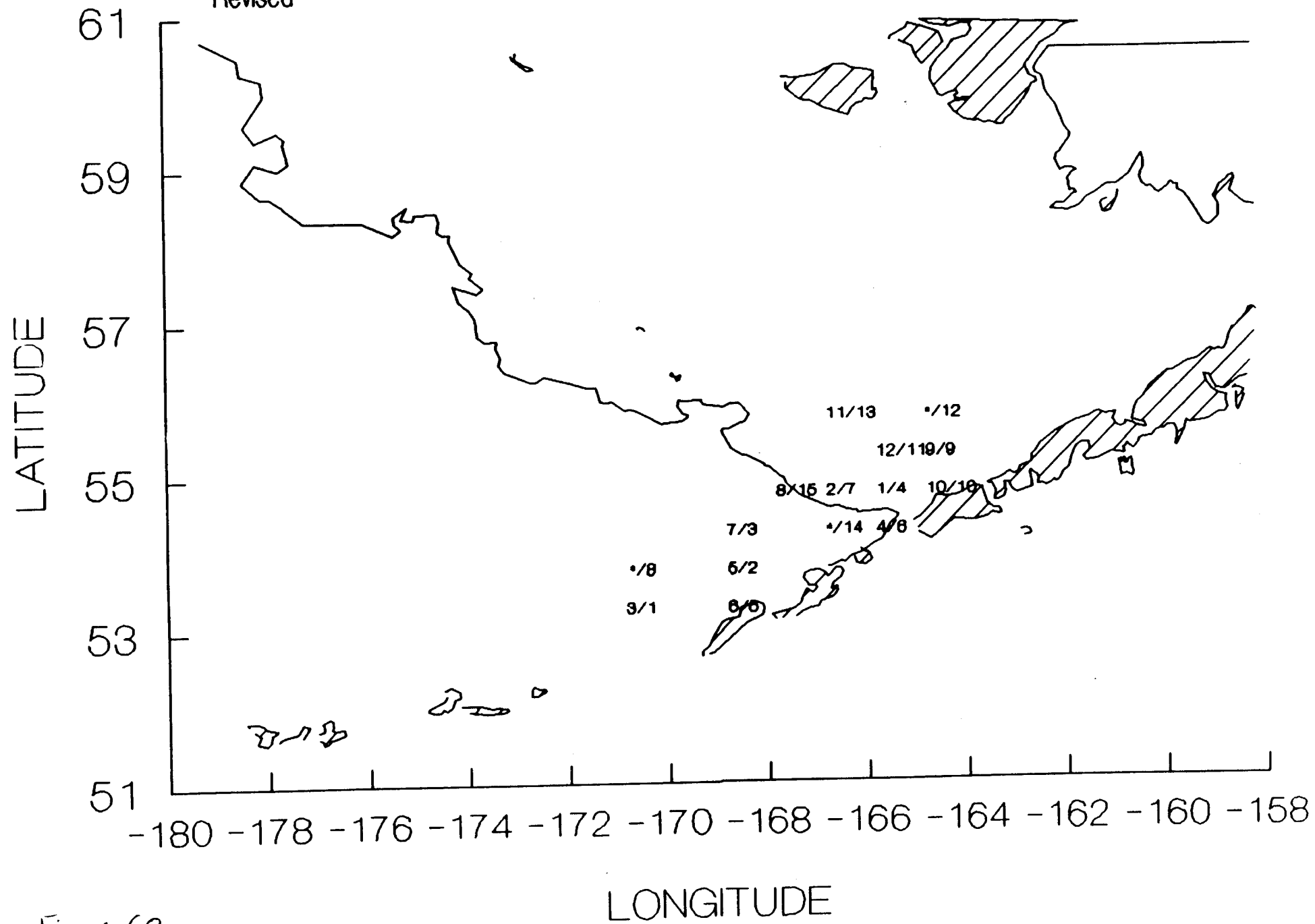


Figure 60

April, 1990. King Rank/Catch Rank. Domestic Pelagic Trawl Pollock
Revised

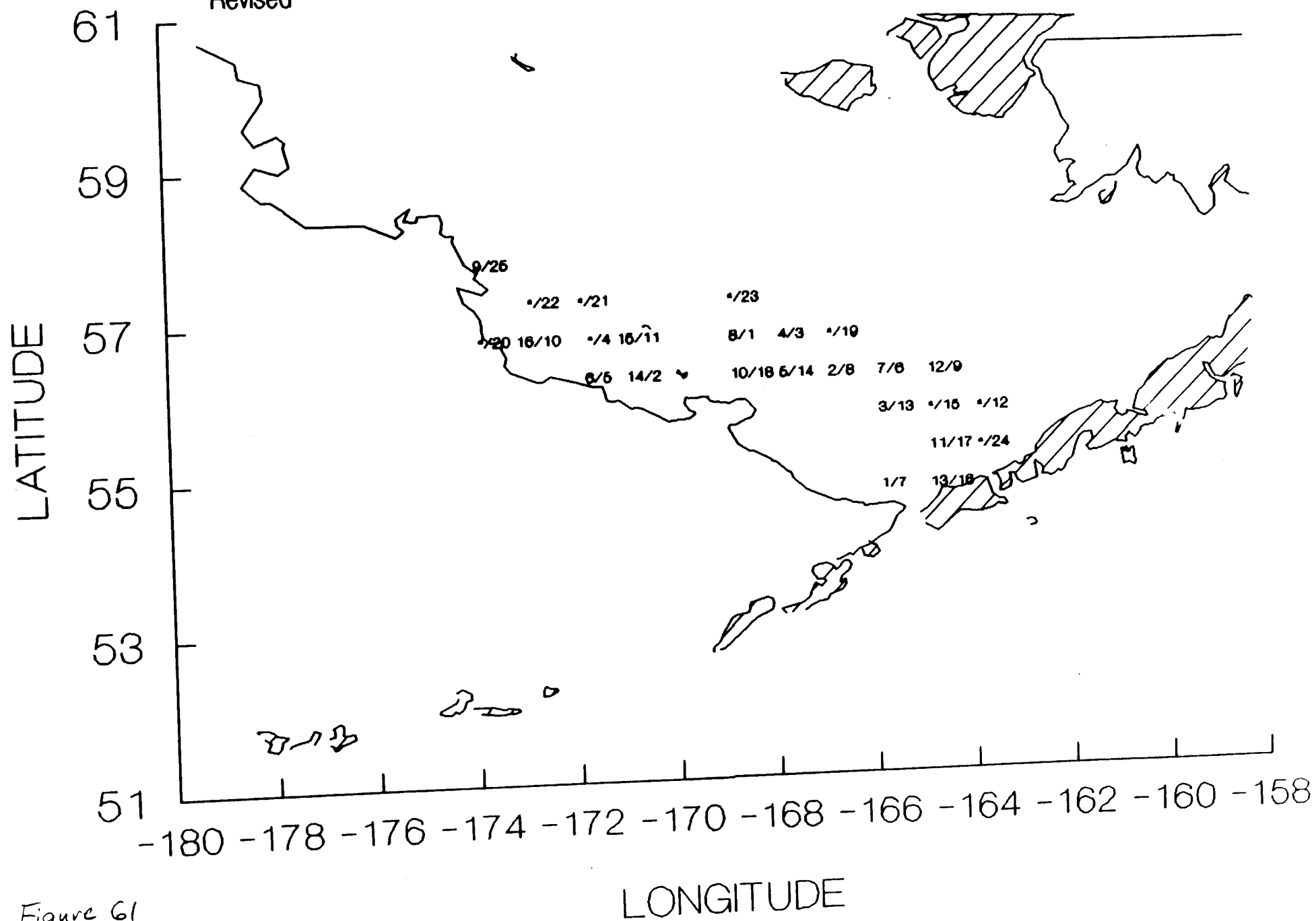


Figure 61

July, 1990. King Rank/Catch Rank. Domestic Pelagic Trawl Pollock
Revised

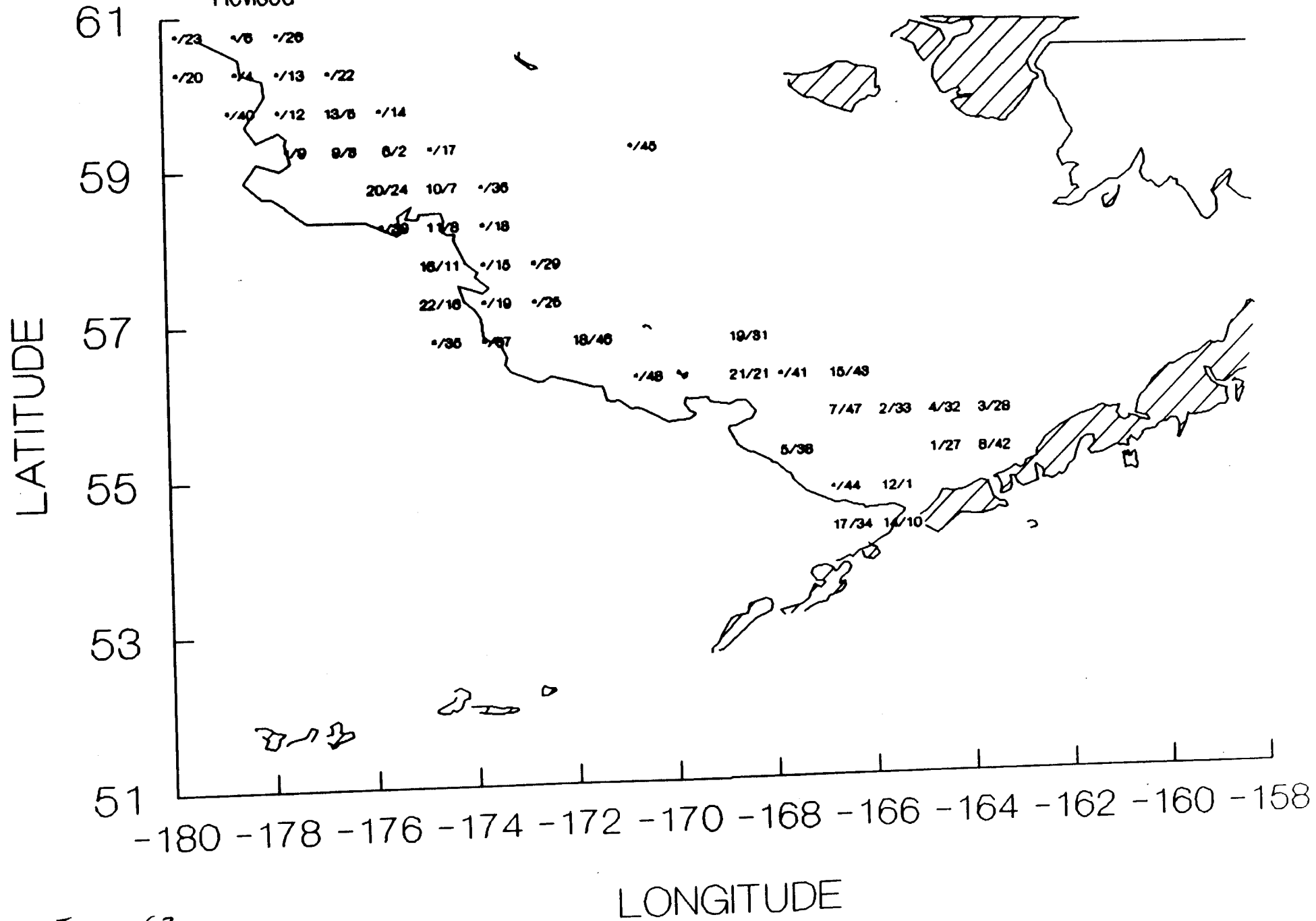


Figure 62

November, 1990. King Rank/Catch Rank. Domestic Pelagic Trawl Pollock
Revised

